Sir Joseph Rajah. 1827

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XIX. SECOND SERIES. Dec. 1, 1803.

Specification of the Patent granted to THOMAS NEWSTEAD, *of Kingston-upon-Hull, in the County of York, Chemist; for a Method of preparing Barilla and Kelp, and the neutral Salts obtained therefrom.*

Dated June 18, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Thomas Newstead do hereby declare, that my said invention is described in manner following; that is to say:

How Barilla and Kelp is to be prepared for Soap-making, Bleaching, and Alum-making.

First. I prepare barilla and kelp to obtain the alkali they contain in a concentrated state by lixiviation, and separating the neutral salts from the alkali.

Second. I decompose the sulphate of potash and sulphate of soda (neutral salts) separated from barilla and kelp.

Third. I prepare the muriate of potash, which I separate from barilla and kelp, for the use of the alum-manufacturer.

Fourth. I separate the neutral salts contained in soap-makers spent lie, their salts prepared from spent lie, and the black ash prepared from their salts or spent lie.

Fifth. I decompose the sulphate of potash and sulphate of soda contained in the soap-makers spent lie, and their salts prepared from their spent lie, and the black ash prepared from their salts or spent lie.

Sixth. How I apply the alkalies and neutral salts to soap-making, bleaching, and alum-making.

1. To concentrate the alkali contained in barilla and kelp, I grind it very small, then saturate any quantity of water my pan will conveniently boil (which is a flat-bottomed cast-iron pan). I add barilla or kelp, by a small quantity at a time, till the boiling water is quite saturated. I then turn the liquor over into a vat, provided with sand to filter. I add about half as much water to the remains in the pan as I had at first, and allow it to boil, and then turn it into the vat to filter. I then fill up the pan with fresh water, and boil the remaining barilla or kelp for a short time; then draw or damp the fire, to allow the residue of the barilla or kelp to fall to the bottom of the pan, which I take out with a proper draining-shovel, and consider it worth nothing more than for manure, or for the use of the glass-manufacturer. I then saturate this water or weak lie with fresh barilla or kelp, and go on as above.

Next I take the filtered liquor, and fill up a flat-bottomed iron or lead pan, and boil till a strong pellicle is formed; this is to be tasted, to know what neutral salt it is; it is mostly sulphate of potash, but is easily known by being very insoluble in the mouth, and feeling like sand

sand between the teeth. When sulphate of potash appears first, which I know from the pellicle, I boil slow, and take out the salt as it falls to the bottom of the pan, frequently tasting the pellicle, to discover when it is formed of muriate of potash, which is the next salt to appear, (as barilla or kelp is never found free of it,) and is known by its strong salt and disagreeable bitter taste. As soon as I find the pellicle formed of muriate of potash, I draw the fire, and allow the liquor to be still for about ten minutes. I then take a draining-shovel, and take out all the salt that has fallen to the bottom of the pan, which will be sulphate of potash. After this is done, I turn the remaining liquor into a cooler, and let it stand till quite cold. I then return it into the pan, to be boiled again till a pellicle is formed, and then to be returned into the cooler, having first taken out of the cooler all the crystals of muriate of potash formed in the last cooling. They must be put into a box or basket to drain dry, and then are in a proper state to be used by the alum-manufacturer. Boiling and cooling is to be repeated till no more muriate of potash is obtained. The remaining is dried down, and consists of carbonate of soda, some sulphate of soda, and a little muriate of soda.

2. To decompose sulphate of potash, I take its weight of carbonaceous matter, such as charcoal, smallcoal, cokes, saw-dust, or tanners' waste bark, and one-third its weight of carbonate of lime (chalk ground), or lime that has been some time slaked. These are well mixed together, and put into a reverberating furnace, and frequently stirred till all the carbonaceous matters be consumed, and the whole be in compleat fusion before drawn out. After which it may be concentrated as in article the first, only there will be some undecomposed sulphate and sulphite of potash, as the only neutral salts which

will be precipitated by boiling, as directed for separating the sulphate of potash. The remaining liquor to be dried down, and will consist of carbonate of potash.

Sulphate of soda is to be decomposed by the same method as sulphate of potash. After which it is to be lixiviated, filtered, and boiled, till a pellicle is formed, and then put into a cool dry place, and in a few days crystals of soda will be formed. The liquor must be drawn from them, and returned to be boiled, and again cooled; this is to be repeated till no more crystals of soda is produced. The remaining liquors will consist of sulphate of soda and sulphite of soda, to be dried down, and again put into the furnace with carbonaceous matters.

3. Sometimes muriate of potash will be found in the cooler uncrystallized; in that case it is to be dissolved in water to a crystallizing pitch, and turned into a cooler, and crystals of muriate of potash will be obtained. This is the best preparation of it for the alum-manufacturer.

4. To separate the natural salts contained in soap-makers spent lies, it it to be filtered, to deprive it of as many impurities as possible. Then a pan is to be filled up, and the liquor to be boiled, as in article the first, to take away the sulphate of potash. Then the liquor is to be cooled, and boiled till no more muriate of potash is obtained, as in the first article. The liquor will then consist of sulphate of soda and a little muriate of soda, to be dried down and decomposed, as also the sulphate of potash first separated.

To separate the neutral salts contained in salt prepared from soap-makers spent lie, I first make it into black ash, by running it through a fusing-furnace; I therefore treat it as black ash, and in separating the neutral salts contained in black ash prepared from soap-makers spent lie, I grind it small, dissolve it, and filter

it;

it; then separate the salts, as I do in the soap-makers spent lie above.

5. To decompose the sulphate of potash and sulphate of soda contained in soap-makers spent lie, salts prepared from their spent lie and black ash prepared from their spent lie or salts.

The sulphate of potash and sulphate of soda to be decomposed and concentrated as in article first and second.

6. In applying the concentrated alkalies to soap-making, nothing more is wanting than to causticise them with half their weight of quick-lime, and use the lie at a strength that it will easily unite with tallow. Any sulphate of soda or muriate of soda not separated is found useful in the operation of soap-making in small quantities.

In applying the concentrated alkalies to bleaching, they are to be causticised (when wanted to be used as potash) with half their weight of quick-lime, and a lie made, which is to be boiled down to a dry salt, and kept close for use. When wanted to be used as pearl or comby ashes, nothing more is to be done to them than to put them into a reverberating furnace, and keep stirring them well till they come nearly to fusion, then taken out and used.

The muriate of potash crystallized is the most advantageous way of using it in the making of alum, and no salt produces more alum than it, except carbonate of potash when pure. The muriate of potash is to be used in the process of alum-making as carbonate of potash.

In witness whereof, &c.

Specification

Specification of the Patent granted to JAMES STUARD, *of London-street, in the Parish of St. Dunstan, Stepney, in the County of Middlesex; for a Method to strengthen Ships or floating Vsssels in such a Manner as may often prove the Preservation of Life and Property.*

Dated July 27, 1803.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said James Stuard do hereby declare, that my said invention is described in the drawing hereunto annexed, (see Plate I.) and the following description thereof; that is to say: The use of my invention is to preserve life and property, by making a ship much stronger than on the common construction; so that should she, by stress of weather, be drove on shore, she will keep upright, and be better able to resist the threatening danger. I lay a keel on each side the middle line, distant from it, including the thickness thereof, one-sixth of the average breadth at loading draft of water, or a little more or less, according to the fullness or sharpness of the ship. Which keels may be bolted through the floor timbers or futtocks, or both, and through keelsons on the inside; to have no keel on the middle line, except for a short length, to connect with stem and stern-post where the side keels end. The keels are marked A A, B B, C C, Fig. 1. The short keels to be bolted through the dead-wood and keelson D D; and the intermediate part of that keelson through the floor timbers, and through a piece of thick stuff, which butts between the short keels. The position of

of the keels as they bear on the ground are shewn at Fig. 2: or if the ship is either of very large dimensions, or exceedingly sharp, the plan Fig. 3 may be most suitable. The distance of the side keels, from out to out, is found by dividing the half breadth draft, Fig. 4, into eight equal parts on the middle line, and take the measure therefrom to the load draft of water line on the seven lines. Add them together, and divide by seven, gives the average half breadth; one-third of which is the distance required; which, being put on the timbers Fig. 5, gives the different depths; which put on B B, Fig. 1, and drawing a fair line, gives the curve of the upper side of the side keels; which keels not only prevent the ship from straining, by keeping her upright when on shore, but strengthen her at all times, make a good foundation for a double row of pillars under the beams, and are advantageous to her sailing, as is evident by Fig. 6, where heeling to an angle of twenty degrees, the lee-keel is one foot six inches deeper in the water than if it was on the middle line, consequently must make her more weather-ley, which may enable her to clear a lee-shore. Ships on this construction may be built without shoring up, and launched without having bilge pieces fitted on their bottom, whereby the coppering may be completed on the stocks. Every beam may be strengthened, and the hull kept from racking or being over strained with carrying sail, by having diagonal carlings between the beams as Fig. 7, which though drawn for an upper deck is equally serviceable for any deck, or the decks may be laid as Fig. 8: those parts where the beams are not covered to be laid fore and aft. Also, instead of working the cieling plank in the common way, if they are done as Fig. 9, the weight of both ends is thrown on the middle, which must tend to prevent hoging. Fig. 9, by being

ing bent at two or three strakes from the keelson will shew one side and half the bottom.

The bottom of barges, or any other vessels, may be strengthened by diagonal pieces, as represented at Fig. 10, which pieces may be either short, to go between the floor timbers, or long, and scored out about half their thickness, to let them down between the floor timbers; also the sides may be strengthened in the same manner, see Fig. 11. Boats with keels on this construction are better adapted for loading on a beech, carrying a large gun, or landing troops; are easily hauled up or launched, and have the same advantage in sailing as ships. The ends of all diagonal pieces to be let in with an abutment, as Fig. 12. Thus have I, either by words or drawn figures, specified my invention; but the form of vessels being so various, it is impossible every particular can be so described as to suit all; but, from the above, and the drawings annexed, any person of ordinary capacity cannot fail to make a proper application.

In witness whereof, &c.

Observations by the Patentee.

A ship thus secured from straining is more likely not to work her plank loose, which often occasions foundering; and if by stress of weather she is unavoidably drove on shore, she has greatly the advantage of ships on the common construction, as they, laying on an edge, easily roll by the agitation of the sea, and strike against the ground, and, when left by the tide, are often bulged by the overhanging weight; but ships on this construction having one-third of their breadth to stand on, will neither roll nor be likely to bulge; and if, from the declivity of

Fig. 7.

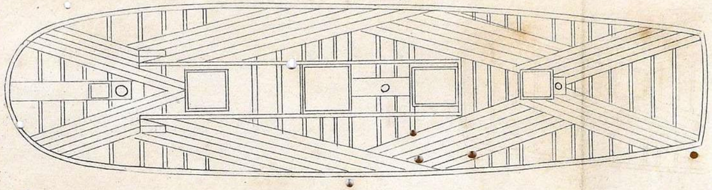


Fig. 8.

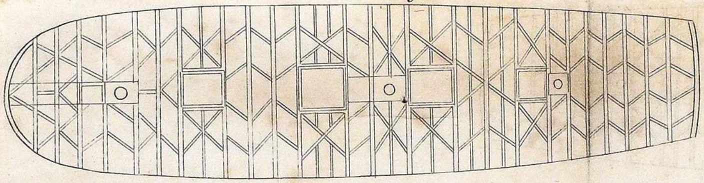


Fig. 9.

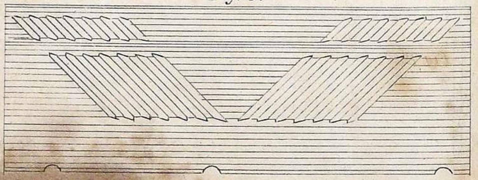


Fig. 12.

Fig. 10.

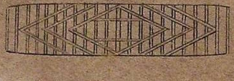


Fig. 11.

Fig. 1.

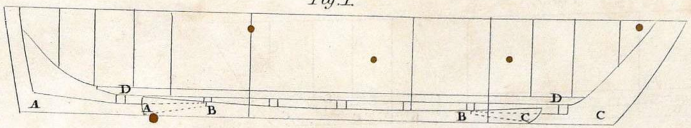


Fig. 2.

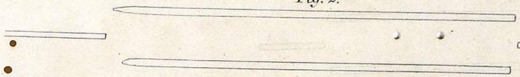


Fig. 3.

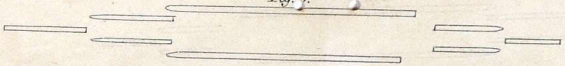


Fig. 5.

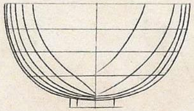


Fig. 6.

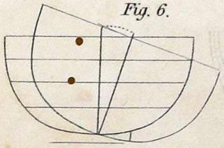
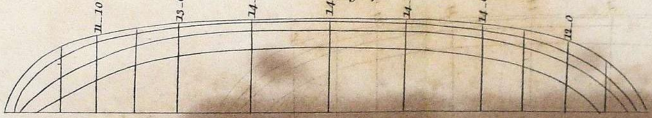


Fig. 4.



of the ground, another ship would overset, this will not, having two-thirds of the weight to counteract it. Therefore, as the preservation of lives and property at sea are of great importance to the community, the above construction of ships are recommended to all whom it may concern. They may be built by any ship-builder in England, &c. by paying unto the patentees a small compensation *per* ton, and shall be furnished with drafts, by applying to St. Barbe and Stuard, No. 6, Cock-hill, Ratcliff.

Specification of the Patent granted to DANIEL CRAANEN, *of Cullum-street, Fenchurch-street, in the City of London, Merchant; for making Verdigris in Lumps or Powder, with Ingredients the Produce of Great Britain.*

Dated November 19, 1802.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Daniel Craanen do hereby declare, that my said invention is described in manner following; that is to say: Upon any given quantity take one part of the very best sal-ammoniac, one quarter part of oil of vitriol, one half part of aquafortis, one quarter part of acid muriatic, and twelve parts of cold spring-water, which, when thoroughly mixed together, is put into sheets of copper, of any size, turned up at the edges about half an inch all the way round, to prevent the mixture from running off. The mixture is then stirred well up every two or three hours, until the same is discovered to be of a green or bluish cast or body. The mixture must then remain a few hours, until it is settled, and the

water at top appears perfectly clear, which will happen sooner or later, it depending upon the temperature of the atmosphere. The water must be then carefully poured off, leaving the sediment at the bottom. It must be then put into any vessel of sufficient size, and if it is thoroughly prepared the paint will bear a washing, to free it from dirt, &c. without mixing with the water; after which washing, the water must be poured from the paint. The paint may then be taken and prepared in lumps by putting the same into moulds of any size that may be convenient, observing afterwards to place the same in a mild warm room. When it is quite dry, it may be ground into powder with ease, or remain in the lumps, as may be convenient; it is then fit for use.

In witness whereof, &c.

Specification of the Patent granted to CHESTER GOULD, *of Red Lion-street, Clerkenwell, in the County of Middlesex, Gentleman; for an Hydrometer on a new Principle, for the Purpose of ascertaining the Strength of Spirits, and determining the specific Gravity of Fluids in general.* Dated September 3, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Chester Gould do hereby declare, that my said invention is described as follows; that is to say: I procure two glass tubes or cylinders, with a bore or calibre, about the size of a goose quill, and thirty inches long. These two tubes I enclose in a brass tube, of such diameter as will receive them with convenience, in order that they may be secure from injury or accident. One

one

one end of these tubes I fit a small cyringe or pump, in such manner as to exhaust the air from both of the glass tubes at the same time with the same cyringe or pump. Then the instrument becomes a double pump, or a pump with two parallel tubes, which are both exhausted by one piston. If water is drawn into both tubes it will rise to an equal height by the weight of atmosphere; but if a column of water is drawn into one tube, and a column of the highest rectified spirit into the other, the two columns will rise to different heights. The different length of these columns will be in exact proportion to their gravity; and this difference will determine the length of a scale which I graduate by actual experiment, by diluting the spirit one *per cent.* at a time, and repeating the experiment till the scale is finished. When it is finished it is fitted to the glass tubes near the cyringe, so as to apply like the scale of an hydrometer. On the other end of the instrument, a small vessel is fitted to receive the liquors. This vessel is separated into two equal parts by a partition, so that one part may be filled with water and the other with spirits, and both remain separate. This partition passes between the two glass tubes. When a sample of spirits is to be tried, one side of this vessel must be filled with water, and the other with the sample to be tried. Then it is drawn into the instrument till the water rises exactly to the bottom of the scale, and the spirits will then rise higher to the proof-mark, or above or below, according to its strength. If a sample of spirits is tried in this instrument by another sample of known proof, the difference will appear on the scale without the assistance of the thermometer, because the state of the atmosphere affects both samples alike, or very nearly so. The size and proportions of this instrument may be varied at pleasure. Some of them are provided with a stop-

cock, for the purpose of more conveniently retaining the fluids in the instrument till the observation is made. This cock is fitted between the cyringe and the end of the glass tubes; and others are made with a cock instead of a cyringe; and then the instrument is exhausted by the mouth, and the cock is turned to retain the liquor in the instrument till the observation is made.

In witness whereof, &c.

Experiments and Observations on the various Alloys, on the Specific Gravity, and on the comparative Wear of Gold. Being the Substance of a Report made to the Right Honourable the Lords of the Committee of Privy Council, appointed to take into Consideration the State of the Coins of this Kingdom, and the present Establishment and Construction of His Majesty's Mint.

By CHARLES HATCHETT, *Esq. F. R. S.*

With a Plate.

Abstracted from the TRANSACTIONS of the ROYAL SOCIETY. By MR. DAVY, of the ROYAL INSTITUTION.

THIS abstract contains the result of a great number of accurate and laborious investigations on the properties of the alloys of gold. They were made at the request of the Lords of the Committee of his Majesty's most honourable Privy Council, appointed by his Majesty on the tenth of February, 1798, to take into consideration the state of the coins of the kingdom.

Mr. Hatchett was assisted in his researches by the valuable advice of Henry Cavendish, Esq. F. R. S. and the machines

machines for ascertaining the wear of the coins were invented by that gentleman.

The full detail of the experiments, which occupied between two and three years labour, are inserted in the Philosophical Transactions for 1803.

The principal object of the experiments was to ascertain, whether the great loss which our gold coin appears to have sustained within certain periods had really been caused, or had been materially influenced, by any important defect, either in the quality of the standard gold, or in the figure or impression of the coin; but, in order to determine this, the decision of two questions became necessary; namely,

First. Whether very ductile gold, or gold as hard as is compatible with the process of coining, suffers the greatest loss, under the general circumstances of friction?

Secondly. Whether coins with flat, smooth, and broad surfaces, wear less or more, than coins which have certain protuberant parts raised above the ground or general level of the pieces?

It appeared, that neither of these questions had ever been decided by actual experiment, and the best informed persons were in every respect much divided in their sentiments; for some conceived hard, and others soft gold, to be the best for coin; and some in like manner believed, contrary to the general opinion, that the pieces which were flat and smooth were more susceptible of wear than those which had fewer points of contact in consequence of protuberances. As therefore nothing certain relative to these matters could be gained from books, nor from those who were consulted, the solution of the questions was attempted by the experiments which will now be described; and for this pur-

pose

pose, the Lords of the Committee furnished the requisite means.

The wear or abrasion of coin is a mechanical effect, subject to be modified by certain physical properties, such as ductility and hardness; and as these last-mentioned properties in mixed or alloyed metals are much influenced by chemical effects, which the different metals mutually produce upon each other, it naturally follows, that the experiments required to investigate the present subject must form three distinct series, in the first of which will be comprehended the chemical experiments, or those which relate to the effects produced upon gold by the addition of different metals in certain given and equal relative proportions.

The second series will include the experiments which relate to the different degrees of density observed in gold when variously alloyed; and, as the specific gravity of standard and other gold has always been regarded as one of the most certain tests of its quality, exclusive of chemical analysis, it appears to be of much importance to ascertain how far this can with certainty be depended upon; and how far, and from what causes, it is liable to unavoidable and occasional variations.

The third and last series consists of those experiments which may be called mechanical, and which were expressly intended to ascertain the comparative wear of different kinds of gold, by various modes of friction.

The account of the whole of these experiments has therefore been digested into three separate parts, corresponding to the three principal series which have been mentioned.

SECTION

SECTION I.

A. From the various experiments made with arsenic and gold, in open and close vessels, it appears, that arsenic combines with gold only under certain circumstances; but when united with it, then the colour and ductility of gold become considerably affected, and the arsenic (although naturally volatile) cannot easily be completely separated, even by long-continued fusion.

B. Antimony more readily combines with gold, under all general circumstances; and it is proved, by the experiments, that $\frac{1}{4}$ of a grain of antimony in the ounce Troy, or the $\frac{1}{1920}$ part of the mass, is sufficient to destroy the ductility of gold.

C. Zinc, whether alone, or mixed with copper in the state of brass, also destroys the ductility of gold; but it is easily separated by heat.

D. Cobalt affects the colour and malleability of gold, until the proportion is reduced to four grains *per* ounce; the effects of it then begin to cease.

E. Nickel is not so injurious to gold as the foregoing metals, as four grains did not produce any remarkable effect; and there is reason to believe, that of all those which are improperly called semimetals, nickel is that which is the least prejudicial to gold.

F. Manganese changes the colour, and considerably injures the ductility of gold.

G. Bismuth is highly destructive of the general properties of gold; for the vapour of it affects that metal even when melted in open vessels. Like antimony, a very small proportion of bismuth, such as $\frac{1}{1920}$ part, is sufficient to render gold completely brittle.

H. The effects of lead upon gold resemble those of bismuth in every particular.

I. Tin

I. Tin is by no means so destructive of the ductility of gold as is commonly believed; for it may be combined in the proportion of eight grains *per* ounce without producing any bad effect. A larger quantity undoubtedly renders gold brittle; but, upon the whole, the effects of tin have been much exaggerated.

K. The effects of iron upon gold have been, if possible, more universally misrepresented and misunderstood than even those of tin; for, contrary to the general assertion and belief, that iron is extremely injurious to the ductility of gold, it is proved, by the present experiments, that gold may be alloyed with the full standard proportion of wrought-iron, cast-iron, and even cast-steel, without being thereby made brittle; and, although a certain degree of hardness is thus produced, yet the metal remains perfectly ductile. The most remarkable effect produced by iron upon gold, is the great alteration of its colour; for by $\frac{1}{12}$ of iron, gold becomes almost white.

L. Many eminent metallurgists have asserted, that emery powerfully acts upon gold, and renders it brittle; but the present experiments prove, that this is a very erroneous idea, as it is impossible to combine emery with gold.

M. Gold when alloyed with $\frac{1}{12}$ of platina remains extremely ductile, but the colour becomes like that of tarnished silver. When gold was alloyed with $\frac{1}{12}$ platina and $\frac{1}{12}$ of copper, it became of a dull yellow, and was not quite so ductile as when platina alone was employed. It may here be observed, that the remarkable change of colour produced by small quantities of platina upon gold, and the peculiar chemical properties of the former metal, render it so easy to be detected, that there does not ap-

pear

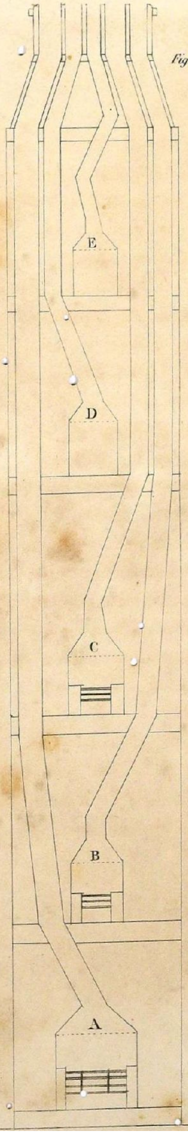
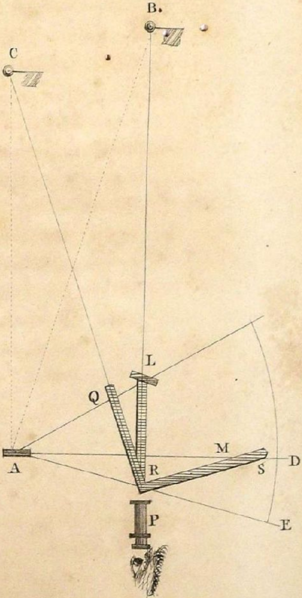


Fig. 1.

Fig. 2. Page 57.



pear any reason to apprehend the employ of it in the adulteration of the gold coin.

N. Copper when pure, and in the proportion of $\frac{1}{12}$, is well known as the metal which is most commonly employed to alloy gold.

The gold thus alloyed is very ductile, and of a deep colour; but when the copper is not pure, then the ductility of gold becomes more or less affected.

There are several kinds of copper known in commerce which are found to be nearly or quite equally proper for general purposes; but when an alloy for gold is required the case is very different; then it appears, that none can so much be depended upon as the fine granulated Swedish copper: for the others, such as the varieties of British copper, and the Swedish copper dollars, which are employed in our mint as an alloy for silver, are found commonly, or at least very frequently, to render the gold brittle, although, in every other respect, they appear to possess all the obvious and general properties of what may be called good and pure copper.

Some of the experiments which have been made for the purpose of the present investigation, prove that antimony or lead may be combined with copper in a much greater portion than what is required to destroy the ductility of gold, while the copper itself suffers no apparent change in colour, ductility, nor in any other characteristic of pure and good copper; so that the presence of antimony or of lead would not be suspected, but by the effects produced upon gold by copper thus adulterated; and as the ores of lead and of antimony so frequently accompany those of copper, as the last portions of these metals are with difficulty separated from copper during the process of smelting, and as instances have even been known of copper adulterated with a large proportion of these me-

tals having been purchased for the use of certain foreign mints, and that the adulteration of the copper was only first discovered by the effects which it produced upon the precious metal, there is every reason to suspect the presence of antimony or of lead in those kinds of copper which in our mint are so frequently found to be injurious, and this suspicion has since been confirmed by various analyses purposely made. It is therefore proper that a previous trial of the copper, intended to be purchased for the use of mints, should always be made upon a small quantity of gold.

The experiments also present another curious fact, which is, that gold, when alloyed with any copper which has a tendency to make it brittle, has this property much increased by being cast in moulds of sand; and, on the contrary, that moulds of iron counteract and diminish the brittle quality of such gold; so that, unless the original degree of brittleness be very considerable, the same gold may be made alternately ductile, or brittle, merely by changing the moulds. But if the copper is pure, then the ductile quality of the alloyed mass always continues the same, whether the metal is cast in iron or in sand.

As copper therefore, when pure, is always uniform in its effects upon gold, and, when employed in standard proportion, forms a metal possessed of considerable ductility, it may be considered to be liable only to one objection; namely, the deep colour which it communicates to gold: but this is too much a matter of fancy to merit attention.

o. Gold alloyed with $\frac{1}{12}$ of pure silver is the most ductile of any of the varieties of standard gold; but it is of a very pale yellow colour; in other respects it does not present any remarkable property.

From

From this concise statement of the results of the experiments contained in this part, it must be evident that, agreeably to general practice and opinion, only two of the metals are proper to be employed to reduce fine gold to standard, *viz.* silver and copper, for all of the others either considerably alter the colour, or diminish or destroy the ductility of gold.

Silver and copper therefore, either separately or conjointly, must be regarded as the only proper alloys for gold coin; but the truth of this assertion, as well as the comparative advantages attending the employ of each of these metals, will be more fully ascertained by the results of those experiments which will be noticed in the subsequent parts of this Report.

SECTION II.

A. In the second part, as has been stated, an account is given of those experiments which relate to the specific gravity of gold made standard by different metals, single or mixed.

This subject does not appear to have been hitherto so fully investigated as it really merits, for the present experiments prove, that many, and even considerable, alterations are produced in the specific gravity of metallic substances by various causes, several of which seem to have escaped the notice of men of science; and there is much reason to believe that the test of specific gravity is by no means so unexceptionable and so decisive as has generally been imagined.

B. The defects of the instruments, and the difficulties which attend the operations, employed in experiments of this nature, being for the greater part well known, they were consequently obviated and counteracted, as much as possible, when the experiments were made.

 Supposing,

Supposing, however, that these experiments are performed with the most delicate instruments, and with all possible care and attention, yet, when metals are to be examined, various circumstances require to be taken into consideration.

The most important of these are, as would appear from the detail of facts,

First, imperfections in the interior of the mass, which are produced during the processes of melting and casting.

Secondly, the difference of density in parts of the same mass, resulting from the quantity and quality of the metal, from the nature of the mould, from the more or less vertical position of it, and from the height of the column or bar of metal.

Thirdly, the unequal mixture of the metal or metals throughout the mass intended to be alloyed.

Fourthly, the peculiar effects which certain metals produce, when employed singly or conjointly as alloys, and which are very different from the results of calculation.

And, fifthly, heat, whether produced by friction or excited in any other manner.

As therefore the specific gravity of metals is liable to be influenced by such different causes, it is almost in vain to expect absolute precision in the results of such experiments; and although, by proper care and attention, a degree of accuracy may be attained sufficient for almost every useful purpose, yet, from what has been said, it must appear evidently absurd to form opinions upon small fractional variations.

From the experiments which Mr. Hatchett made, with every possible precaution, upon separate and entire ingots of gold reduced to standard by silver, by silver and copper,

copper, and singly by copper, it was proved, that the specific gravity of each of these kinds of standard gold was as follows.

Gold made standard by silver	17.927
Gold made standard by equal parts of silver and copper	17.344
Gold made standard by copper	17.157

Now as our gold coin frequently, and indeed commonly, contains silver as part of the alloy, and as at different times this proportion of silver must have been various and even considerable, particularly when the gold of Portugal (which is alloyed with silver) was employed, it naturally follows that, exclusive of the many other causes of variation which have lately been enumerated, the specific gravity of our standard gold must occasionally be different, according to the relative proportions of silver and copper which compose the alloy; and as the specific gravity of gold made standard by silver is 17.927, while that of gold made standard by copper is only 17.157, so, according to the relative proportions of these two metals when united in the alloy, the specific gravity of standard gold may vary between the two extremes of 17.927 and 17.157; or indeed, when some allowance is also made for small variations arising from other causes, the whole range of the different specific gravities of gold made standard by silver and copper may be considered as extending from 18 to 17.

SECTION III.

The third and last part contains the account of the result of the experiments intended to ascertain the comparative wear of gold when variously alloyed.

A. As

A. As the preceding experiments had fully proved that silver and copper are the only metals proper to be employed as alloys for gold, it appeared superfluous to subject to friction all the other varieties of standard gold which have been formerly mentioned.

The experiments now under consideration were therefore principally confined to fine gold, and to gold made standard by silver, by silver and copper, and by the different kinds of copper known in commerce; these consequently produced considerable varieties in the degrees of comparative ductility and hardness; but, in order more completely to investigate the subject, some experiments were also made upon gold much debased by copper, as well as upon pieces of standard silver, and upon others of pure copper.

B. The whole of the experiments which compose this third part may be divided into three subordinate series, the two first of which were directed to the consideration of that part of the diminution of the coin which arises from the rubbing of one piece of metal against another.

The third series was intended to show the comparative power of gold, differently alloyed, to resist abrasion from sand, or other gritty powders.

The general results of these extremities are;

First, that when equal friction, assisted by a moderate pressure, takes place between pieces of coin which are of a similar quality, then abrasion is most commonly produced in an inverse ratio to the degree of ductility.

Secondly, that the contrary effect happens when pieces of different qualities rub against each other; for then the more ductile metal is worn by that which is harder.

And, thirdly, that earthy powders and metallic filings produce similar effects, and tend to wear the different

kinds

kinds of gold in proportion to their respective degrees of ductility.

D. Fine gold, being extremely soft and ductile, sustains a considerable loss under many of the general circumstances of friction; and, as at all times it appears certain, that the impressions which have been stamped upon it are most easily obliterated, even when actual abrasion does not take place, there is much reason to conclude, that gold of such extreme ductility is not that which is the most proper to be formed into coin.

E. But gold of the opposite quality, or at least so hard as to be but just capable of being rolled and stamped, seems to be equally improper for that purpose; for even supposing that hard or brittle gold suffered in every case less by friction than that which is moderately ductile, (which is not however the fact,) and allowing that standard gold may by a mixed alloy be rendered as hard as gold reduced by copper to 18 carats, without changing the standard proportion of gold, yet it would be very difficult always to make such standard gold of an uniform degree of hardness. Moreover, by some experiments purposely made by Mr. Hatchett at the mint, upon the rolling and stamping of gold of different qualities, it evidently appeared, that gold, equal in hardness to that of 18 carats, could not be employed with advantage; for the additional labour which was required for the rolling and stamping of this hard gold, the frequent failure in making the impression, and the bruising and breaking of the dies, fully proved, that the expense and difficulty attending the working of such gold could by no means be compensated by the small degree of durability which it might possess over any other.

F. The extremes of ductility and of hardness being therefore equally objectionable, it follows of course, that

gold

gold of moderate ductility must be that which is the best adapted for coin; and, as nothing but silver or copper can be employed to alloy gold which is intended to be coined, it may be here observed, that, whatever might have been the original motive for introducing the present standard of 22 carats, yet it appears, from the experiments, that this standard proportion of $\frac{1}{12}$ of silver or copper is (every circumstance being considered) the best which could have been chosen.

There is however some difference in the quality of gold when alloyed with the standard proportion of silver, of silver and copper, and of copper, which requires to be considered.

G. Gold alloyed with one-twelfth of silver is of a fine but pale yellow, it is very ductile, it is easily rolled, and may be stamped without being annealed; it consequently does not require to be blanched; and, after the complete process of coining, the surface and every part remains of an uniform quality, so that by wear it does not appear of different colours.

These properties are certainly much to be valued, but the objections to this kind of standard gold are,

First, the additional expense attending the employ of silver as an alloy.

Secondly, the extreme pale yellow colour.

And, thirdly, that, from its great ductility, it is almost as liable to have the impressions which have been made upon it speedily obliterated as those which have been made upon fine gold. All things being therefore considered, gold alloyed only with silver does not appear to be so proper for coin as may at first be imagined.

H. Gold, made standard by a mixture of equal parts of silver and copper, is not so soft as gold alloyed only with

silver,

silver, neither is it so pale, for it appears to be less removed from the colour of fine gold than either the former or the following metal. Gold alloyed with silver and copper, when annealed, does not become black, but brown; and this is more easily removed by the blanching liquor or solution of allum than when the whole of the alloy consists of copper. It may also be rolled and stamped with great facility; and, under many circumstances, it appears to suffer less by friction than gold alloyed singly by silver or by copper.

After it has been, however, subjected to the ordinary friction, which must take place during the circulation of money, it is liable to appear of a deeper colour in those parts which, being prominent, are consequently the most exposed to friction; this defect arises from a cause which will soon be explained, but it cannot be regarded as an objection of any weight.

1. The last kind of standard gold which remains to be mentioned, is that which is alloyed only by copper. This is of a much deeper colour than those which have been hitherto noticed, and is slightly harder than either of them, but nevertheless it is very ductile, provided that the copper be pure. It requires to be annealed, and then becomes nearly or quite black; which colour is not so easily removed by the blanching liquor as that which is produced by the process of annealing upon gold alloyed with a mixture of silver and copper.

Gold made standard by copper suffers less, by many of the varieties of friction, than gold which is alloyed with silver; but in some cases it seems to wear rather more than gold alloyed with silver and copper; the difference is not however very considerable.

This sort of standard gold, as well as that which is alloyed with silver and copper, appears commonly, after a

certain degree of wear, more or less of a deep copper colour in those parts which are most prominent; and when coin thus alloyed exhibits such an appearance, it is frequently and vulgarly said to have been in contact with copper money; and sometimes guineas, having this appearance, have been refused, upon the supposition that they have been debased; but the real fact is, that when copper constitutes part or the whole of the alloy, it becomes oxidized or calcined upon the surface of the blanks, by the process of annealing, and the blackish crust of copper, in this state, must then be removed by the solution of alum, called the blanching liquor; now it is evident, that after this operation, the surfaces of the blanks or unstamped pieces can no longer be regarded as standard gold; for if copper singly forms the alloy, it must be dissolved, and be separated from the surface of each piece of coin; and the same effect must also take place with respect to the copper in the alloy formed of copper and silver; so that, in the first case, each piece, when blanched, will consist of gold made standard by copper, covered with a thin coat of fine gold; and, in the second case, each piece will be composed of gold made standard by silver and copper, coated with gold, alloyed with $\frac{1}{24}$ of silver, or with half of the standard proportion of alloy, supposing the silver and copper to have been in equal quantities; as therefore the standard gold, of which the pieces consist, is always more or less of a deeper colour than the coating or film of the finer gold which covers each piece, it must be evident, that when this coating has been rubbed and removed from the raised or prominent parts, these will appear of a very different and deeper colour than the flat part or ground of the coin.

The

The reason is therefore sufficiently apparent, why gold, which is alloyed with silver, cannot be liable to this blemish.

K. Upon a comparison of the different qualities of the three kinds of standard gold which have lately been mentioned, it appears (strictly speaking) that gold made standard by silver and copper is rather to be preferred for coin; but as gold made standard singly by copper is but very little inferior in its general properties, it may be much questioned whether the few and small advantages possessed by the former would compensate the additional expense of the silver required for half of the alloy; and it may be farther remarked, that any extraordinary addition of silver appears to be less necessary, as there is commonly some of that metal in the gold which is sent to the mint, and which, being reckoned as part of the alloy, must be productive of advantage.

L. When a general view is taken of the results, there does not appear to be any very great or remarkable difference in the comparative wear of the above three kinds of standard gold, all of which suffer abrasion slowly, and with great difficulty; and (as has been already observed) the difference of wear between the two last-mentioned is certainly but inconsiderable; for these reasons therefore, and from the consideration of every other circumstance, it cannot be doubted that the very great loss which the gold coin of this kingdom is stated to have sustained within a certain limited time, cannot, with even a shadow of probability, be attributed to any important defect in the composition or quality of the standard gold, and all that can be said upon this subject is, that some portion of this loss may have been caused by the rough impression and milled edge now in use, by which each piece of

coin acts, and is acted upon by the others, in the manner of a file.

The loss thus occasioned cannot however be considerable, for the quality of the present standard gold is certainly well adapted to resist abrasion, especially in the case of the friction of coin against coin, and this is strongly corroborated by the observation of bankers and others, who are in the habit of sending or receiving large quantities of gold coin from any considerable distance.

When a number of guineas, rather loosely packed, have been long shaken together by the motion of a coach or other carriage, it has been observed, that the effects of friction chiefly fall upon only a few of the pieces; but it is very remarkable, that although these are often reduced nearly or quite to the state of plain pieces of metal or blanks, yet, upon being weighed, they are found to have sustained little or no loss; and from this it appears, that the impressions have been obliterated not by a real abrasion of the metal, but by the depression of the prominent parts, which have been forced into the mass, and are reduced to a level with the ground of the coin.

Pieces of hard gold would not so easily suffer by depression, but the real loss would probably be greater, they being (in the case of the friction of coin against coin of a similar quality) more susceptible of abrasion.

Upon the whole, there is every reason to believe, that our gold coin suffers but little by friction against itself, and the natural and fair wear probably arises principally from extraneous and gritty particles, to the action of which the coin may occasionally be exposed in the course of circulation; but it is nevertheless certain that the united effects of every species of friction to which coin

may

may be subjected fairly and unavoidably during circulation, cannot produce any other wear than that which is extremely gradual and slow, and which will by no means account for the great and rapid diminution which has been observed in the gold coin.

Description of the Instruments employed in the Experiments on the comparative Wear of Gold when alloyed by various Metals.

In the first series of experiments, twenty-eight pieces of coin were fixed to a frame, and over each of them was placed another piece, which was pressed against it by a weight. These upper pieces were all connected to a second frame, so that, in consequence of the motion communicated thereto by cranks, each upper piece was rubbed backwards and forwards upon that which was under it.

Fig. 1, (Plate II.) represents a plan of this instrument; and Fig. 2 is a vertical section of it, drawn parallel to the line A B.

The upper frame, or that to which the upper pieces of coin are connected, is of brass, and consists of four bars, Fig. 1, A B, B *b*, *b a*, and *a* A, with three cross bars C *c*, C *c*, C *c*.

The lower frame consists of a board, placed immediately under the upper frame, and is expressed in Fig. 2, by the letters L L.

The upper frame is supported by two vertical boards, extending the whole length of the sides B *b* and A *a*, so that the ends of them are seen in Fig. 2, and are denoted by the letters D D, D D. These boards are fastened to the upper frame, and to the table upon which the apparatus stands, by hinges, so that the upper frame can move freely in the direction B A, but can have no motion in the direction perpendicular thereto. These vertical boards

boards are omitted in Fig. 1; for, as the intention of this description is not to give a detail of all the parts of the instruments, but only to explain their manner of acting, I have taken the liberty to omit such parts as tended to produce an intricacy in the figures, without being necessary to this object.

The disposition of the pieces of coin on the frames is represented in Fig. 1. N *n n*, denote one of the connecting pieces, by which the upper pieces of coin are connected to the upper frame, and in which the small circle represents the position of the coin; the large circle is the part which supports the weight, and *n n* the part by which it is connected to the upper frame.

To avoid confusion, neither these connecting pieces nor the pieces of coin are represented in Fig. 2; but, instead thereof, a section of one of these pieces is given in Fig. 3, upon a larger scale.

In this figure L L is the lower frame, and C one of the bars of the upper frame; *y*, is one of the lower pieces of coin, which is bedded and fixed firmly in a brass socket *x*, fastened to the lower frame; *u*, is the piece of coin to be rubbed against it, which, in like manner, is fixed in another brass socket *w*; N *n*, is the connecting piece by which this socket is connected to the bar C of the upper frame. This piece turns on pivots, in two studs *n*, fixed to the bar C, so that it can turn freely on those pivots in a vertical direction, but cannot be perceptibly shaken horizontally.

Z is the weight by which this connecting piece is pressed down; it is round, and is placed with its center exactly over that of the socket *w*.

It must be observed that, in the construction of this machine, three things principally demanded attention.

1st. That

1st. That the pieces of coin should all move equally.

2dly. That they should all be pressed against the lower pieces by the same weight. And,

3dly. That they should bear flat against them.

As to the first requisite, it is evident that the pieces must all move alike, excepting so far as proceeded from the springing of the parts of the machine, or from the shake in its joints, both of which were very small.

Secondly, as the connecting pieces move freely in a vertical direction, it is clear that the force with which the upper piece of coin is pressed against the lower one, depends only on its own weight, on that of the socket *w*, on that of the connecting piece N *n*, and on the weight Z, by which it is loaded; so that the second requisite is thus easily obtained.

Thirdly, the connecting pieces N *n* bears against the socket *w* only by the pin *p*, which enters into a hole in the centre of the socket, so that the two pieces must necessarily bear flat against each other; but as this pin alone would not have prevented the socket from turning round on its centre, two other pins π π were fixed into the connecting piece, and entered into slits made in the socket near its circumference, allowing no more shake than was necessary to prevent it from sticking; and thus the motion round the centre was effectually prevented.

It may be observed, that the pieces might have been made to bear flat against each other by fixing the sockets *w* in gimbals; but as the method above described was effectual, and much easier made, it was preferred.

It may be also remarked, that the breadth of the bars C *c*, as represented in Fig. 1, is not sufficient to prevent them from springing considerably; for this reason, a method of strengthening them was employed, which answered

swered the purpose perfectly well, but is omitted in the drawing, as it could not be easily represented.

It was at first intended, that the lower frame should have remained fixed, and that only the upper one should have moved; but, in a previous trial, in which two pieces of metal were rubbed backwards and forwards upon each other in the same line, with a view to discover what weight would be necessary to make the pieces wear tolerably fast, I found that for a time they diminished slowly, but that little furrows or gullies were soon worn in them, and that then the diminution was rapid. I also observed, that the gullies in the upper pieces corresponded to those in the lower ones; so that it was impossible that the pieces of metal should touch each other in those places where the diminution was most rapid, and consequently the gullies must have been formed by the particles of metal which had been abraded, and which subsequently had become accumulated.

It seemed to me, that the most probable way to prevent the little furrows or gullies from being thus formed, would be, to construct the instrument in such a manner, that the direction in which the pieces rubbed upon each other should continually vary. The following contrivance was therefore adopted, by which the pieces were prevented from rubbing together twice in the same direction.

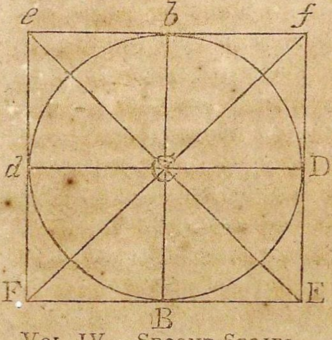
In this method, the lower frame, as well as the upper, is supported on two moveable vertical boards; but, whereas the boards supporting the upper frame are placed parallel to B *b*, in consequence of which the frame can move only in the direction B A, these are placed parallel to B A, so that the frame can move only in the direction B *b*.

E E, is the axis by which the upper frame is moved: this turns in fixed sockets at S S, and is turned at each end into the form of an eccentric circle, which acts as a crank; so that, by means of the levers E K, which at one end turn on these eccentric circles, and at the other end turn on joints fixed to the upper frame; this frame is made to move one-fourth of an inch in the direction B A, during one-half of the revolution of the axis, and as much in the contrary direction, during the other half revolution.

[illegible], is an axis of the same kind, serving to move the lower frame. H H is a windlass, which turns these two axes by means of the toothed wheels F *f*, which work in the toothed wheels G *g*, fastened to the axes E E and *e e*. T T T T T is the table upon which the apparatus stands.

The wheel F has ninety teeth, *f* has seventy-five, and G *g* have each twenty; so that the axis E E makes six revolutions while *e e* makes five; and, at a medium, these axes make about four revolutions to one of the windlass. A counter is placed so as to show the number of revolutions of the windlass.

If the two frames had performed their vibrations in the same time, no advantage would have been gained, for the pieces of coin would still have moved upon each other always in the same line; but, as their vibrations are performed in different times, the effect is quite different; for let C, in the annexed figure, be the centre of one of the pieces in the lower frame. Draw the



lines B *b* and D *d* in the directions of the motion of the lower and upper frame, and equal to the space which those frames describe in one semi-revolution of the cranks, and complete the square of *e f* E F. Then, if the upper frame is moving with its greatest velocity in the direction D *d*, at the same time that the lower one is moving with its greatest velocity in the direction B *b*, the motion of the upper piece on the lower one will be in the diagonal *f* F; but if, at that time, the lower frame is moving with its greatest velocity in the contrary direction *b* B, the motion will be in the other diagonal E *e*.

If one frame is moving with its greatest velocity while the other is at the extremity of its vibration, the motion will be in the circumference of the circle *b* D B *d*, inscribed within the square; and, in the intermediate cases, it will be in the circumference of an ellipsis, which is inscribed in the same square, and whose axes are in the diagonals *e* E and *f* F, but in which the proportion of the axes is continually changing; that axis which is placed in F *f* being sometimes the greatest, and at other times the least.

This contrivance, therefore, effectually prevented the pieces from moving upon each other always in the same line; and it seems also to have much diminished the disposition which they had to wear in gullies, but not intirely; for, from the following experiments it appears, that still some few particles would become occasionally collected, and then acted as a grinding powder, which accelerated the wear of the pieces. This was observed particularly to happen to the pieces of gold alloyed with an equal proportion of copper, and to the pieces of copper which were also more frequently worn in furrows or gullies, than the other pieces of more ductile metal.

The

The motion of the pieces of coin upon each other is greater than it would have been if only one frame had been made to move nearly in the proportion of three to two; so that the whole motion of the pieces, in each semi-revolution of the axes E E or *e e*, is about three-eighths of an inch, and therefore it is about three inches in each revolution of the windlass.

The instrument employed in the second series of experiments is so simple as not to require any drawing. It consisted only of a cubical box of oak, which measured eight inches each way within side. This box was moved by the axis E E of the former instrument, which was passed through the middle of two opposite sides, and was fixed in that position.

Fig. 4 represents a plan of the instrument used in the third series of experiments. *a a a*, is a horizontal table, turning upon a vertical axis; and B B B *b b b* is a fixed frame surrounding it.

The pieces of coin are fastened to this fixed frame by the same connecting pieces which were formerly employed, and are pressed down also by similar weights. The diameter of that part of the wheel against which the centres of the pieces of coin are pressed is twenty-nine inches; so that, while this wheel makes one revolution, the pieces are rubbed against it through the whole circumference of this circle, that is through $91\frac{1}{10}$ inches.

A shallow groove *g g g* is cut in this wheel, in that part against which the pieces are pressed, in order to confine the powders employed in the experiments; and the number of revolutions of the wheel are marked by a counter.

Hints regarding Cattle. By Sir JOHN SINCLAIR.

FROM ESSAYS ON MISCELLANEOUS SUBJECTS.

INTRODUCTION.

THE object that every intelligent farmer ought to have in view, who breeds and maintains domestic animals, *is profit;* consequently he ought to find out, as Bakewell happily expressed it, "*the best machine for* "*converting herbage, and other food for animals, into* "*money.*"

For that purpose, it is necessary to ascertain the shape and nature of the animal which makes the most profitable use of the food it eats: that, however, must depend much on the price of the different articles which the animal produces. For instance, tallow formerly bore a higher price than meat, and consequently was a greater object in the breeding of cattle and sheep than at present, when it sells at an inferior price *, and the various articles produced from it have become so valuable, as to render a good dairy-cow the most profitable of all our domestic animals, and consequently entitled to peculiar atten-

* It would be a curious and important subject of inquiry, to endeavour to ascertain the real price, *and the relative value*, of beef, tallow, and leather, at different periods, more especially within the last century. It is evident, that the farmer must always aim at producing those articles which will yield him the greatest profit; and at present flesh must be the object; for my butcher informs me, that on the day on which this note is written, (25th January, 1802,) beef is sold at 9½ d. per lb. and tallow at 5¾ d. per lb. or 3 s. 11 d. per stone. Flesh consequently is to tallow as 38 is to 23. It is therefore for the advantage of the farmer, as the market now stands, to produce flesh rather than tallow.

attention *. Meat, however, is at present the object most generally attended to; and it is certain that the breeding of cattle and sheep for the shambles was never carried to such perfection as it has lately been brought to in England.

The cause of this it may not be improper briefly to explain.

Stock, in general, (and this is still the case in a multitude of instances, and must always be so when the breeder has not food at command, calculated for fattening as well as rearing his cattle,) was formerly bred by one set of men, fattened or prepared for the market by a second, and killed by a third †. Whilst these three occupations continued distinct, with only occasional communications or intercourse with each other, no great improvement could be effected. That division of labour,

* It is much to be regretted that the real value of a good dairy-cow is not more generally known. I am assured, by a most respectable country gentleman, (Walter Trevelyan, Esq. of Nether Witton, in Northumberland,) that a well-bred Teeswater cow will give, on an average, fourteen quarts at each of two milkings, or twenty-eight quarts per day. Some of the Teeswater breed, according to Culley (page 40), give even to the amount of thirty-six quarts per day. But calculating at twenty-eight quarts, this, at 4 d. per quart, amounts to 9 s. 4 d. per day, and in six months to 84 l. Another intelligent gentleman, who has had great experience in cattle-farming, observes, that any cow, at all calculated for the dairy, will, in seven months milking, pay double her price to the butcher. Take, for example, an Irish or Scotch cow, calving in May, and value the grass she eats at 3 l.; if she gives from ten to twelve quarts per day the farmer will not only be indemnified for attendance, rent, &c. but at the end of the season he will have the cow for nothing. Can there be a greater inducement to dairy-farming.

† The intermediate occupations of drovers, salesmen, &c. have no occasion to acquire any peculiar knowledge (excepting as to the state of the markets in various parts of the kingdom) different from that of the other professions above mentioned.

or

or separation of professions, so useful in manufactures, was pernicious to this important branch of agriculture, by preventing the principles on which the improvement of our domestic animals might be effected from being ascertained *.

A person, however, of strong natural sagacity, (Robert Bakewell, of Dishley, in the county of Leicester,) though he did not unite to the extent that his disciple, Culley, has done, the two distinct occupations of breeder and grazier, yet having acquired great skill in grazing, by preserving his breeding-stock in the highest possible condition, and having called in to his aid all the skill and experience which the butcher had acquired, was thus enabled to ascertain the principles, not only of breeding domestic animals, so as to answer the common expectations of the farmer, but also of bringing them to a degree of perfection, of which, before his time, they were scarcely supposed capable: and by directing the public attention in general, and that of the farmer in particular, to the art of breeding, he has in various respects most essentially benefited his country. By his example that most important system was very generally established, of certain breeders directing their whole attention to the rearing of males, and letting them for the season, at such prices as would amply indemnify the breeder for all the care and expence he had bestowed upon them; a practice which had originally taken place in Lincolnshire, but had never been carried to any great height till adopted by Mr. Bakewell.

* But when the properties essential in forming a perfect breed are fully ascertained, the separation of occupations above alluded to will become useful, as one farm may be better calculated for breeding, another for fattening, &c.

In

In discussing the important subject of cattle, it is proper, in the first place, to observe that a distinct breed of cattle may be formed, 1, in consequence of the soil of the country, and the vegetables it produces; 2, from the climate, which, in various respects, must affect the animals living under its influence; 3, from a particular shape, size, or colour becoming fashionable, and consequently in great demand; 4, from the nature of the animals that may be imported into it from other counties; and, 5, from the various crosses which have been made among breeds in some respects distinct, and from which a new variety may arise.

It is not proposed, however, to attempt any particular enumeration of the various breeds in these kingdoms; for though differing in regard to colour, size, &c. they claim, in many respects, the same valuable properties. The great object, therefore, to ascertain is, what particulars are essential to form a perfect breed; because, if these are once pointed out, there is no sort that may not be improved by attentive breeders, either by crossing with other stock, or by selecting the best specimens of the breed itself, so as to acquire the qualities that may be wished for. These particulars may be considered under the following general heads, namely. 1. Size. 2. Shape. 3. Disposition. 4. Hardiness. 5. Aptitude to feed. 6. Early maturity. 7. Milk. 8. Quality of flesh. 9. Fat. 10. Hide. And, lastly, Fitness for working.

Of the Particulars essential in forming a perfect breed.

1. *Size.* It is difficult to lay down any general rule for the size of cattle, as so much must depend on the nature of the pasture, and on the means which the grazier has for ultimately fattening them; nor has it yet been

proved,

proved, by decisive and repeated experiments, whether the large or the small sized pay best for the food they eat. The experiments ought to be made with similar breeds, but of different sizes, and the particulars to ascertain are, whether it does not require a much greater quantity of food, 1, to rear a great ox than a small one; 2, to feed him when working; and, 3, to fatten him afterwards. A large calf certainly requires more milk than a small one, but if it pays as well for what it consumes, or grows in proportion to what it takes; there is no objection, on that account, on the score of profit; nor if a large ox eats more, provided he works proportionally more than a small one. In regard to fattening, the experiments of Lord Egremont are rather favourable to the opinion, that fattening stock do not eat in proportion to their weight, but that a small ox, when kept in a stall, will eat proportionally more, without fattening quicker than a large one.

Without pronouncing decisively on a question so much contested, as whether large or small cattle ought to be preferred, (which will require indeed a great number of experiments finally to determine,) I shall endeavour shortly to sum up the arguments made use of on either side.

In favour of small or moderate sized cattle, it is contended, 1. That a large animal requires proportionally more food than two smaller ones of the same weight. 2. That the meat of the large animal is not so fine grained, and consequently does not afford such delicate food. 3. That large animals are not so well calculated for general consumption as the moderate sized, particularly in hot weather. 4. That large animals poach pastures more than small ones. 5. That they are not so active, consequently not so fit for working. 6. That small cows, of the

the true dairy sort, give proportionally more milk than large ones. 7. That small oxen can be fattened with grass merely, whereas the large require to be stall-fed, the expense of which exhausts the profit of the farmer. 8. That it is much easier to procure well-shaped and kindly-feeding stock of a small size than of a large one. 9. That small-sized cattle may be kept by many persons who cannot afford either to purchase or to maintain large ones; and, lastly, if any accident happens to a small-sized animal the loss is less material *.

In favour of the large-sized, it is on the other hand contended; 1. That without debating whether from their birth till they are slaughtered, the large or the small ox eats most for its size, yet that, on the whole, the large one will ultimately pay the farmer as well for the food it eats. 2. That though some large oxen are coarse-grained, yet that where attention is paid to the breed, the large ox is as delicate food as the small one. 3. That if the small-sized are better calculated for the consumption of private families, of villages, or of small towns, yet that the large ox is fitter for the markets of large towns, and in particular of the metropolis. 4. Even admitting that the flesh of the small-sized ox is better when eaten fresh, yet the meat of the large-sized is unquestionably better calculated for salting, a most essential object in a maritime and commercial country, for the thickest beef, as Culley (p. 47) justly remarks, by retaining its juices when salted, is the best calculated for long voyages. 5. That the hide of the large ox is of infinite consequence in various manufactures. 6. That where the pastures are good, cattle

* There is a number of important observations on the size of cattle in Dr. Anderson's Recreations, vol. III. p. 1; and, on the subject of the dairy, p. 161. 241. 321. 401, and vol. IV. p. 1 and 81. See the eighth volume of the first series of this work.

will increase in size, without any particular attention on the part of the breeder, which proves that large cattle are the proper stock for such pastures. 7. That the art of fattening cattle by oil-cake, &c. having been much improved and extended, the advantage thereof would be lost, unless large oxen were bred, as small ones can be fattened merely with grass and turnips. And, lastly, that large cattle are better calculated for working than small ones, two large ones being equal to four small ones, in the plough or the cart.

Such are the arguments generally made use of on both sides of the question; from which it is evident that much must depend upon pasture, taste, markets, &c. But, on the whole, though the unthinking multitude may admire an enormous bullock, more resembling an elephant than an ox, yet the intelligent breeder (unless his pastures are of a nature peculiarly forcing) will naturally prefer a moderate size for the stock he rears; or, perhaps, may adopt that plan of breeding, according to which the males are large and strong, and the females of a small size, yet not unproductive to the dairy *.

2. *Shape* †. It is extremely desirable to bring the shape of cattle to as much perfection as possible; at the same time profit and utility ought to be more attended to

* See Mr. Knight's valuable account of the Herefordshire breed. Communications to the Board of Agriculture, vol. II. p. 172. The Herefordshire, Devonshire, and Suffex, resemble each other much in this respect.

† It is a common saying with farmers, "*that all breed goes in at the* "*mouth*," and it is certain that no animals can be well shaped unless they are well fed, both in summer and winter. It is almost incredible how much the same breed will improve when they are better taken care of. That, however, ought neither to prevent selection nor judicious crossing.

than

than mere beauty, which may please the eye but will not fill the pocket, and which, depending much upon caprice, must be often changing.

As to the shape of cattle, however, breeders seem to concur in regard to the following particulars, to wit, 1. That the form ought to be compact, so that no part of the animal should be disproportioned to the other. 2. That the carcase should be deep. 3. Broad. And, 4. That the head, the bones, and other parts of little value, should be as small as possible.

It is evident, however, that the form ought to be adapted, as much as possible, to the wishes of the consumer. For instance; if cattle are to be sold in London, or in other places, where beef for rump-steaks is much in demand, and sells higher than any other parts of the carcase, that is an object to be attended to in cattle bred for the Smithfield, or any similar market, which would not be essential in other counties where no such distinction is made in the meat that is consumed.

3. *Disposition.* It is of great importance to have a breed distinguished by a tame and docile disposition, without however being deficient in spirit. Such a breed is not so apt to injure fences, to break into other fields, &c.; and unquestionably less food will rear, support, and fatten them. As tameness of disposition is much owing to the manner in which the animal is brought up, attention to inure them early to be familiar and docile cannot be too much recommended.

4. *Hardiness.* In the wilder and bleaker parts of the country, hardiness of constitution is a most important requisite; and, even where stock is best attended to, it is of essential consequence that they should be as little liable as possible to disease, or any hereditary distemper; as be-

ing *lyery*, or black-fleshed *, or having yellow fat †, and the like. It is a popular belief, that a dark colour is an indication of hardiness; and that cattle with light colours are softer and more delicate. A rough pile is also reckoned a desirable property in a Highland breed; and, above all, *in out-winterers*, as they are called, or cattle kept out all winter, those who will face the storm, and not those who will shrink from it, are in request ‡.

5. *Easily maintained.* It is well known, in the human race, that some individuals eat a great deal, and never get fatter; whilst others, with little food, grow immoderately corpulent. As the same takes place in regard to cattle and to other animals, it is evident how important it must be to ascertain the circumstances which produce a property so peculiarly valuable in them. Bakewell strongly insisted on the advantage of small bones for that purpose; and the celebrated John Hunter declared, that small bones were generally attended with corpulence in all the various subjects he had an opportunity of examining. It is probable, however, that a tendency to fatten arises from some peculiar circumstance in the internal structure of the body, of which small bones are, in general, an indication; and that it is only in this point of view that they ought to be considered essential, for they often weigh as heavy, and consequently require as much nourishment as large ones. Small bones, like those of the blood horse, being compact and heavy: large bones, like

* Culley on Live Stock, second edition, p. 48. It is singular that these black-fleshed animals have little or no fat within or without.

† See Middleton's Middlesex, p. 576.

‡ It is remarked in the Highlands, that in bad weather hardy cattle keep their back-bones straight, whereas soft ones bend them. Hence the crooked appearance of bad cattle.

those

those of the common dray or cart horse, being extremely porous, and consequently light for their apparent bulk. Indeed, cattle ought not only to be easily maintained, in point of quantity, but, in remote and uncultivated districts, in regard to the quality also of the food they consume; and it is certain, that some particular animals will fatten as well on coarse fare as others will do on the most luxuriant.

6. *Early maturity.* Arriving soon at perfection is a material object for the breeder, as his profit must in a great measure depend upon it. This is a circumstance indeed not only extremely material to the farmer, but in a populous country, where the consumption of meat is great, to the public also; as it evidently tends to furnish greater supplies to the market. In regard to this point, however, some wish to make a distinction between sheep and cattle; as the latter, they affirm, might pay for its keep by working or by milk. But is not the farmer indemnified for the expense of maintaining sheep by the valuable manure it yields, and the fleece which it annually produces, which, when manufactured, is the source of such profit to the community *?

7. *Milk.* The dairy is such an object in many parts of the kingdom, and it is so desirable to have a living machine that can convert, in abundance and perfection, the food it eats, to so useful, so profitable, and so essential an article as milk, that the breed the most distinguished for that property must always be in request. Whether a particular breed ought to be kept up for that sole pur-

* In regard to early maturity, both as to sheep and cattle, it evidently depends much on the animal being constantly kept in the best possible order, for if it is once suffered to fall back, it requires a considerable space of time, and much trouble and expense, before it can recover what it has lost.

pose,

pose, or whether it is preferable to have stock partly calculated for the butcher and partly for the dairy, is a point well entitled to the most deliberate discussion. It is probable that, by great attention, a breed might be reared, the males of which might be well calculated in every respect for the shambles, and the females of which might, when young, produce abundant quantities of good milk, yet when they reached eight or nine years of age might be easily fattened. This would be the most valuable breed that could be propagated in any country, and indeed some of the best English and Scotch breeds have almost reached that point of perfection.

8. *Quality of Flesh.* The quality of the flesh must certainly depend much upon age and sex, as old cattle must have firmer flesh than young, and heifers must be finer grained than oxen. The excellence of the meat also must depend much upon the size of the animal, and the food on which it is fattened. On the whole, however, there is no better sign of good flesh than when it is *marbled*, or the fat and lean nicely interwoven, and alternately mixed with each other. Some of the Scotch breeds, (the most northerly in particular,) when properly fed, and when they arrive at a proper age, enjoy this quality in great perfection; and hence there cannot be either wholesomer food, or more delicious eating.

9. *Fat.* The advantages or disadvantages of fattening cattle and sheep, at least to the extent usually practised at present, is a point that has of late attracted much public attention. But any controversy upon that subject must necessarily arise from want of proper discrimination. Fat meat is generally accounted more nourishing than lean; but then none, except persons in the most vigorous state of health, can digest it; consequently it is unfit for general consumption. Dr. Willich, in his Lectures on

Diet

Diet and Regimen, very justly observes, "that though "fat meat is more nourishing than lean, (fat being the "cellular substance of animal jelly,) yet, to digest this "oily matter, there are required, on account of its dif-"ficult solubility, a good bile, much saliva, and a vi-"gorous stomach *." Fat meat also, unless prepared with peculiar care, is apt to lose much in cooking; but there are modes by which no loss is sustained in dressing it, which remove that objection. For instance, the keelmen of Newcastle purchase great quantities of fat meat. Being generally of Scotch extraction, they follow the custom, so usual in Scotland, of boiling their meat; the broth of which feeds the family, whilst they themselves eat the meat, generally in a cold state, and in great quantities, and are thus enabled to go through the heavy labour they usually undergo. In many districts manufacturers and others bake their meat with potatoes under it, and the fat, melted by the fire, falls upon the potatoes, and improves much their taste, and the nourishment to be derived from them. In either of these ways, little, if any, of the substance of the meat is lost. But, according to the usual mode of boiling or roasting fat meat, the loss is considerable, and the meat itself is far from being well calculated for nice or delicate stomachs. The art of fattening animals, however, is one that seems fit to be encouraged, as likely to promote useful knowledge; and although, in the course of trying a number of experiments, some excesses may be committed, yet, on the whole, much advantage must be derived from them.

* Willich's Lectures on Diet and Regimen, third edition, page 316. Dr. Stark's experiments go to prove, that three ounces of the fat of boiled beef is equal to a pound of lean. See a tract, printed An. 1801, intituled, "Practical Economy," &c.

10. *Hide.*

10. *Hide.* It is well known, that the grazier and the butcher judge of the aptitude that any animal has to fatten from the touch of the skin. When its hide feels soft and silky, it strongly indicates a tendency in the animal to take on meat; and it is evident, that a fine and soft skin must be more pliable, and more easily stretched out to receive any extraordinary quantity of flesh, than a thick or tough one. At the same time, thick hides are of great importance in various manufactures. Indeed they are necessary in cold countries, where cattle are much exposed to the inclemency of the seasons; and in the best breeds of Highland cattle, the skin is thick in proportion to their size, without being so tough as to be prejudicial to their capacity of fattening. It appears, from Columella's description of the best kind of ox, that the advantage of a soft skin is not a new discovery, but was perfectly well known to the husbandmen of ancient Italy.

Lastly, *Working*. It is a most important question, not yet finally ascertained, whether the public or the individual gain by working oxen *. In the infancy of agriculture,

* It is ingeniously remarked, that the working of oxen must necessarily increase the number, and only *suspends* the consumption. In the Survey of Northumberland, by Messrs. Bailey and Culley, some calculations will be found extremely unfavourable to the working of oxen. In fact, it is a general and complicated subject; as the question is not, whether oxen or horses can be worked at the least expense, but whether, by working horses, and feeding oxen, more butcher's meat will not be sent to the market? as oxen, when not worked, may be ready for consumption so much earlier than otherwise can possibly be effected. In favour of oxen, it is to be observed, that a ruminating animal will be served with one-third less food than another of equal bulk, that does not possess that property. The reason is, that ruminating animals have stronger digestive organs, and every thing capable of being

ture, when husbandmen had inconsiderable capitals, and little work to do, it might be for their interest to use oxen, as they were cheaper to rear and to maintain, and would always fetch something. But the great farmers of modern times, who have large capitals to act upon, and constant occupation for their teams, will generally find it advisable, though they may employ oxen for some purposes, yet, on the whole, to make use of horses. At the same time, the population of a country may increase so much, that the ground must be cultivated, either by the hands of man, as in China, or by animals which man will eat; and the price of beef may become so high as to cast the balance in favour of oxen. On these grounds it is desirable, that the general breed of cattle in a country should be capable of working. Indeed, as stock ought to produce something, even when rising to their full growth, if oxen are not to be worked, cows ought to be more generally kept, as the produce of their milk is so profitable, unless where pasture is of little value, as in Wales, or the mountainous districts of Scotland and Ireland.

These short hints contain the substance of what has occurred to me on the principles of breeding cattle; and the result is, that cattle ought to be,

1. Of a moderate size, unless where the food is of a nature peculiarly forcing.

2. Of a shape the most likely to yield profit to the farmer.

ing converted into chile, or nourishment, is extracted from the food. But a horse's stomach is not fitted for this; so that a greater quantity of food is necessary to extract the same nourishment. See White, on the Natural History of the Cow; Manchester Memoirs, vol. I. p. 442.

3. Of a docile disposition, without being deficient in spirit.

4. Hardy, and not liable to disease.

5. Easily maintained, and on food not of a costly nature.

6. Arriving soon at maturity.

7. Producing considerable quantities of milk.

8. Having flesh of an excellent quality.

9. Having a tendency to take on fat.

10. Having a valuable hide. And,

Lastly, calculated (should it be judged necessary) for working.

CONCLUSION.

I shall conclude with observing, how desirable it would be that, under the auspices of the Board of Agriculture, some person were appointed, perfectly competent to the task, and who had leisure to do justice to such an undertaking, to whose care and talents the important task might be committed of drawing up a detailed system on the subject of cattle. But in order to make such a work complete, more especially that part of it which relates to the diseases of cattle, it would be necessary to collect intelligence, not only from every district in these kingdoms, (which might easily be done, by circulating queries for that purpose, and granting premiums to those by whom the best answers were returned,) and also to extract useful information from the writings of Young, of Marshall, and of Anderson, and from the various publications of the Board of Agriculture, but to apply even to foreign countries for the knowledge they can furnish; and, with that view, it would be proper to carry on a regular correspondence with the most distinguished societies in foreign parts, who have directed their attention

to rural improvements. By collecting the information and experience of the different countries in Europe upon that, and other subjects of a similar nature, there is every reason to hope that the art, not only of breeding and managing domestic animals, but also every other branch of agriculture might be brought to a degree of perfection, which otherwise must be unattainable.

[*The Appendix to the foregoing Article in our next.*]

On the Means of abolishing the horrid Practice of sweeping Chimneys by Children. Communicated by the Author, in a Letter to the Editor.

With a Plate.

Mr. Editor,

NOTWITHSTANDING the great and meritorious exertions which have been made during many years, by the humane part of the public, to abolish the barbarous practice of sweeping chimneys by children — notwithstanding many machines have been invented capable of performing the operation, in most cases, quite as well as children, and in many even better, yet no progress has been made towards accomplishing the salutary end at which all have aimed. The author of this paper, who is one amongst the number who have contributed their aid to this laudable design, and who has bestowed much consideration on the subject, is convinced, from the futility of every attempt yet made, that there is but one way of effectually eradicating this enormous evil, this disgrace to humanity. And when it appears that the means are as simple, and as easily executed, as the object is desirable, it is matter of amazement that this execrable practice has

remained so long unchecked in a civilized country. Of what avail are useful machines when they are to be put into the hands of those persons whose interest it is to destroy them, or, which is the same thing, of those who, from ignorance or prejudice, feel convinced that such machines if used would abolish the lucrative part of their trade. Such *is* the opinion and prejudice of master chimney-sweepers against the use of any machine. And as all attempts to counteract this prejudice, and to induce them to adopt machinery, have failed, there remains but one remedy for the evil, and that remedy dwells in the powerful arm of the legislature. Nothing less than a positive law to prohibit the employment of children in this trade, with severe penalties both on employer, and master-sweeper, can effect the reform desired. By the help of such a law the object will be instantaneously accomplished. Master chimney-sweepers will immediately find the means of performing this operation by inanimate agents; or, should they be at a loss, the simple methods practised in most country places may be resorted to — a bundle of furze, or other such material, tied to a cord, and pulled up and down the chimney, will answer the end in four cases out of five, even as chimneys are now constructed. But if the legislature would interfere to stop the present evil, it probably would go farther, and lay down rules for future buildings, that should remove all difficulty in the application of machinery (if it is not a burlesque on the word) to the object in question. Rules to this effect I apprehend would easily be formed by any intelligent architect, or by a committee of the most enlightened part of the profession.

But lest I should be suspected of recommending laws to restrain one evil without having discovered the means of preventing another taking place in its room, I beg

leave

leave to shew the methods which have occurred to me of accomplishing this very desirable end, and although they may not be the best which can be devised, yet of this I am certain, they are so good that few objections can with justice be opposed to them. This opinion may appear presumptive; but when the reader is informed that all the merit the author of this paper claims is only recommending those rules to be established by law which a very ingenious architect (totally unknown to the author, and probably not now in being) has recommended to the attention of his profession, the appearance of presumption will cease.

The principal object of the architect to whom I allude was the prevention of smoky chimneys in all future buildings; and, in a publication * on that subject, he introduces some remarks respecting the sweeping of chimneys, which I shall take the liberty of copying; as likewise a section of a stack of chimneys, so contrived as, in my opinion, would, if adopted, not only accomplish his first object, but mine also.

Reference to Plate III.

Fig. 1, is the section of a stack of chimneys, five stories high, for a first-rate house.

A, kitchen-chimney. B, parlour chimney. C, first-floor. D, second-floor. E, garrets.

By this section it will be seen that there are only two easy angles in each chimney, consequently if chimneys are constructed of regular dimensions from top to bottom, either square, oblong, or circular; they may be swept with great facility by any soft elastic substance forced from top to bottom. The circular form will be

* See an "Essay on the Construction and Building of Chimneys, &c." By Robert Clavering.

the

the best, because it will be most completely cleaned by the substance forced down it, and because it is the most difficult for children to ascend. The only objection to it is a trifling extra expense in its first construction. The objection to the square and oblong forms is, that whatever substance is employed to clean them will not so readily accommodate itself to their shape, but will be apt to leave the soot in the angles, and therefore subject to take fire occasionally, or to fall into the fire-place. In other respects, the soot left in the angles would cause no inconvenience, because the smoke ascends in a circular form, and never occupies the angles of the funnel but when forced into them by obstructions to its natural current.

The inside of every chimney should be well plastered (pargeted) with materials that will take a smooth and hard surface *.

If these *rules* were observed in building chimneys, it is plain no great ingenuity would be required to invent proper implements to sweep them; but these rules never will be observed, nor the practice of employing children

* A good plaster is made as follows, *viz.* to two bushels of good stone lime, add one bushel of fine drift gritty sand, and a like quantity of sea-coal ashes, or brick dust; skreen them fine, beat and incorporate them together, for the first coat; and, when well set, put on the following for the second or finishing coat. Take fine white plaster, (commonly called plaster of Paris,) mixed with stale small beer, and work it well in a trough or tub to a due consistence; then lay on a fine thin coat of it upon the other, carefully worked in, and as smooth and even as possible. In a short time it will assume the hardness of stone, and a polish little inferior to marble. A funnel thus executed and finished can never be the cause of smoke; and if the expense be a trifle more, to a gentleman who desires a well finished habitation, it can be no object.

in this barbarous trade ever abolished, without the force of LAW.

With respect to chimneys already built, there would be very little difficulty in sweeping them with furze, &c. provided children were not allowed. Wherever a spherical body not less than six inches diameter would find its way from top to bottom, sweeping by furze, &c. might be performed; and where it would not, the chimney ought to be condemned *; and the district surveyor appointed to inspect and see it repaired; as such obstruction would be evidence, not of its original defective construction, but of some decay that might endanger the house by the soot taking fire.

Chimneys built a century or more ago are very wide at the bottom, and sometimes with ledges, formed by the awkward manner of building in those days; but they are generally within a man's reach, so that if the ball stop there, the soot will also, and can be easily removed.

Mr. Clavering says, no chimney ought to be less than ten inches square, and few will require to be greater than sixteen. If this be confirmed by experiment a very few sizes might be given as general rules, and, if observed by builders, a very few implements would be required by the sweepers to answer the purposes of their trade. For instance, suppose the kitchen chimney sixteen inches square, parlour and first-floor fourteen, bed-chamber twelve, attics ten, thus four tools to fit these chimneys are all that will be necessary. And if circular funnels be constructed an equal number of circular brushes would be required.

* This also requires the force of LAW; for, if human beings are not prohibited from this trade, they will be resorted to in these cases, and the chimney will be swept in the usual way, till an accident perhaps destroys the house, &c.

Mr.

Mr. Clavering says, "the method he would recommend for sweeping circular funnels, is to have a strong round brush, made full to the size of the funnel, and about two feet in length with a staple at each end, for cords to be fastened to: if this is drawn up and down the chimney by a man at the top and another below, the chimney will be swept clean in the most perfect manner, as it is practised in the North of England, where I have been; and, as I am also informed, in Scotland and Ireland. A loose bunch of furze will clean a square funnel equally well. The ready way to perform this operation, is, to drop the lower end of the cord down the chimney to the man below, with a piece of lead or a stone fastened to it, and the brush to be put in at the top, and so pulling up and down by degrees all the way, which will perfectly clean the chimney. If the man below ties his end to a mop-stick, he may play it up and down behind a chimney cloth without injury to his eyes. This method is preferable to sweeping by boys; for the plastering on the inside of the funnel will not be hurt by the brush: but will be liable to be broke by the boys with their iron scrapers and brush heads, who will also be tempted to dig holes in the plaster for their feet. The circular funnels will seldom want sweeping, for being smooth and regular the soot will not adhere to the sides as in the corners of common square funnels: however, no chimney that is used ought to remain unswept once, at least, in the year. The late act of parliament respecting fires in chimney dictates this precaution."

Thus, I flatter myself, it will appear that this great evil may be redressed, without inconvenience or injury to any one, and with a very trifling variation only in the means of carrying on the trade of sweeping. It will continue in the same hands in which it now resides; the same

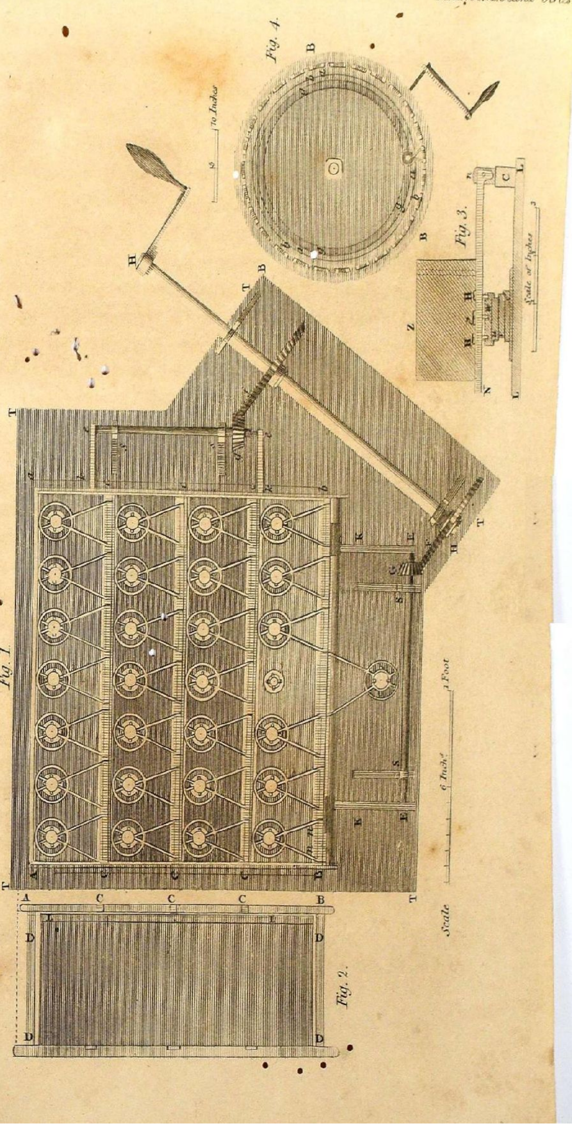


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Scale
6 Inch.s
1 Foot
Scale of Inches
10 Inches

same apprentices may be employed that are now engaged, but not in the same dangerous and pernicious way; so that the master in the art will have no interest in opposing the alteration of the practice.

The members of parliament who shall be instrumental in forwarding this wholesome law will receive the blessings of those oppressed little beings whom it will relieve, and the praises of all mankind.

On the Employment of the Aërostatic Machines in the Military Science, and for the Construction of Geographical Plans. By A. F. Lomet, *Adjutant-commandant, formerly Keeper of the Models at the Polytechnic School, and now Chief of the Sixth Division of the War Department.*

With a Plate.

From the Journal de l'Ecole Polytechnique.

Aërostation is yet in its infancy; it is therefore of importance to obtain the assistance of learned men and artists in this interesting pursuit; but as investigations in this art are generally too expensive for individuals, it seems necessary that government should support an establishment particularly devoted to the practice and improvement of it.

Aërostats will furnish, in presence of an enemy, one or more points of observation at pleasure, from which the positions he occupies may be reconnoitred, his movements studied, and his manœuvres judged of in the gross, or appreciated in the most minute detail. It may be presumed that these machines will become of the most indispensable utility in war, because they supply it with an extraordinary means, hitherto unknown, of making observations,

servations, which may in an instant determine the fate of battles, secure the dispositions for a vigorous defence, or at least point out the moment and the most convenient outlets for a retreat; and more particularly to draw attention to the advantages which an army may derive from balloons, it will be sufficient to remember the happy use made of them at the battle of Fleurus.

The Committee of Public Safety, and afterwards the Executive Directory, thought that the application of aërostats to military enquiries of every description ought to be studied and practised during peace. They were also desirous, that they might be employed in the construction of geographical plans, or at least in ascertaining the intermediate particulars of the territory between the points which had been geometrically determined. Having been charged with the experiments relative to these different applications, I purpose giving an account of the principal results.

The intention, from the first ascents, was to measure the angle formed by the visual rays falling on the eye of the aërial observer, from several determinate points on the earth. The unavoidable motion of the aërostat preventing the use of the graphometer in this operation, a recipiangle was at first substituted, suspended like a mariner's compass, by the assistance of which it was hoped the measure of the angles would be easily taken, and particularly that they would be obtained with immediate relation to a horizontal plane. This attempt not having succeeded, it was necessary in future to make use of a sextant.

This instrument was every thing that could be desired for celerity, as well as for the facility and precision of the observations, but it has this inconvenience, in the case in hand, that it only shews the angle on a plane inclined to the

the horizon; and moreover, in its ordinary construction, it furnishes no means of noticing this inclination. The perpetual agitation of the machine is another source of error; in fact, an aërostat, kept elevated and held by cords, is continually changing position; it moves in space, describing alternate ellipses, the curvature of which is modified to infinity, according to the violence of the wind, the elasticity of the cords, and the situation of the places to which it is fastened. It leaves then no trace of its variations, and does not permit the observer, which it supports, to add to the measure of any angle whatsoever, that of the two angles necessary to connect the first with the plane of the horizon.

Nevertheless, for plans relative to the generality of military inquiries, and in all cases where a sketch of the figure of the earth is sufficient without attending to slight inaccuracies in distances, simple observations, made with the sextant, will answer the purpose, and furnish the means of operating with facility over a vast extent of territory, secure from the attempts of an enemy. But it is not equally serviceable in operations which require a rigorous exactness, and in which it is requisite to connect the angles with the centre of the station, and with the plan of the horizon.

The following is the mode in which I have endeavoured to fulfil the various objects:

The angles necessary for connecting the position of two objects with the centre of the station and the plane of the horizon, are, first, the angle comprehended between the rays falling on the eye of the observer from these points; second, the angles formed by each of these rays with the perpendicular.—We have seen, that it is impossible for the aërostatic observer to mark these three angles by taking them after each other; but if their measure were instan-

taneous, the difficulty would be overcome. This would therefore be the case if an instrument could be devised, which would give these three angles at once by a single observation; and as the sextant already shows the angle comprehended between the rays, the object in view is to add the necessary parts to that instrument for obtaining the other two at the same time.

Let B A C (Fig. 2, Pl. III.) be the angle formed by the visual rays A B, A C; falling on the mirror A of the sextant from the objects B and C; if the index A D be moved until the image of the object C reflected by the mirror A placed on the index coincides by double reflection on the mirror L, with the point where the object B is seen; and if they be both perceived at the same time by the observer looking through the telescope P, it is known, (by the theory and use of the sextant,) first, that the angle D A E, comprised between the index A D and the fixed radius or line of zero A E of the instrument, is always equal half the angle B A C, the measure of which is required: second, that the line R B, which is supposed to pass through the axis of the telescope and the centre of the mirror L, is always directed to the point B, and is usually taken for the side A B; the error arising from the small distance A R being considered as nothing in practice: hence, if we suppose a visual ray passing from the point R to the object C, the angles B R C and B A C may be reputed equal, and be taken indiscriminately for each other.

This being premised, if a ruler be placed in the direction R B, it may be considered as in that of the side A B, and if we can succeed in fixing a second ruler in such a manner that the moveable index shall carry it into the direction R C, at the instant that the images of the two objects B and C are brought into one at the point L,

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it is evident that these two rulers will form between them the angle B R C, and consequently the angle B A C.

To accomplish this, let us suppose a sort of false square, S R Q, situate in the plane of the instrument, and moveable at its axis on a pivot fixed at the point R, at the intersection of the lines A R and R L; making the angle S R Q, comprised between its arms, equal to the angle E R L, and the side R S equal to the distance A R. If now we suppose that the extremity S of the side R S is retained by a button in a groove M N, worked in the moveable index, the movement of it will be communicated to the false square in such a manner that the angle L R Q will always be equal to the angle B A C, and consequently the side R Q will be placed in the requisite direction.

In fact, the triangle A R S being isosceles in its form, the exterior angle S R E = R A S + A S R. = 2 R A S = B A C; but S R Q being equal to E R L, if the common angle S R L be taken away, there will remain the angle S R E = L R Q = B A C.

Now let us fix, under each of the two rulers R L and Q R a small graduated quadrant, suspended in such a manner that it will place itself in the vertical plane of the side corresponding to the angle observed; let us affix to each of these quadrants a plummet, composed of a stiff arm, moveable upon a pivot, and furnished with a nonius index and a weight, which gives it a constant tendency to assume a vertical position, in whatsoever situation the sextant may be placed; finally, let the whole be so disposed that the index of each plummet may be retained at will, at the division indicated on the limb by the effect of the suspension, and this by means of a trigger, which can be pulled at the exact instant of observing the principal angle in the points of reflection. It is evident

evident that the simultaneous action of the two rulers and the plummets will show the three angles sought, and that nothing remains but to reduce, by calculation, the angle B A C to the plane of the horizon.

This instrument, arranged in the manner here described, produced every desired effect in our experiments. The invention, as simple as it is happy, may become very important from the useful application of which it is susceptible; and there is already reason to hope that, by bringing this to perfection, or by the formation of some analogous instrument hereafter, there will be a possibility of executing trigonometric operations with much correctness, by the assistance of aërostatic machines, notwithstanding their continual motion.

It was not enough to have discovered the means of connecting the angles with the plane of the horizon: it was still desirable, that all the angles observed during ascents in any one place should have a relation to the common centre of observation. To accomplish this, it was necessary to keep a register, by some means, of the situation of the machine at the precise moment of measuring each of these angles. This was done by dropping from the aërostat, at that instant, a small stake, leaded, and furnished with an iron point. This stake fell rapidly to the earth, into which it stuck, and marked a point corresponding to the summit of the angle measured. It was then easy to compare the position of this point with that of one taken for the common centre of the observation, and thence to deduce the necessary corrections. It must however be noticed, that the stake, when abandoned to itself, acquires, at the instant of its fall, a compound motion, which partakes of that of the aërostat, and consequently is not exactly vertical; but the error which results from this deviation is but slightly perceptible in practice.

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The calculations and ordinary processes of descriptive geometry will furnish all the means of making use of these different observations, and of expressing the results on paper; not only for their application to the construction of maps, but also to ascertain heights compared with the level: but we shall not in this place enter into any details on that head.

The observer engaged making these first experiments, soon perceives that the involuntary embarrassment, occasioned by the novelty of his situation, when he finds himself insulated and suspended at a height of seven or eight hundred metres, has a considerable influence both on the fidelity of his observations and on the time necessary for making them. All certainty depends, in fact, upon the confidence and readiness of the observer; and it cannot be concealed, that it may produce great inconveniences, because this difficulty of operating opens wide limits for the errors which it is possible to commit.

From this last observation it will be seen: first, that it is indispensably necessary to have acquired a great aptitude for these sort of observations, to be able to execute them with precision: second, that the processes just described are more satisfactory in theory than they would be in those applications which require strict accuracy; and that, though there are situations in which nothing can be substituted for their use in the construction of some figured plans, it is at least proper never to use them in preference to those means of observation which are better known, and which can be employed with more certainty.

But it cannot be too often repeated, at the same time, that aërostats furnish the means of giving the most lively interest to the delineation of the figure of the earth, in

maps

maps of all descriptions; and that their use is of the greatest assistance in the formation of plans, the outline of which may be sufficiently defined by a simple eye-sketch. The aërial observer, by discovering a vast extent of country, accustoms himself fully to consider the general organisation of the asperities of the country, and even the particulars of its varieties, as well as the tone of colour, which appear to give a different character to each portion of territory. If this new method of observation be cultivated with assiduity, it will doubtless lead to a sensible improvement in the art of drawing plans. But to benefit by the advantages which it affords, it is necessary that those who are destined to this employment should join a profound knowledge of geometry to a great facility in designing landscapes. May they be convinced of the importance of this truth, and assure themselves that no part of the plan can arrive at perfection, either ornamental, or relative to civil and military purposes, unless strict accuracy in the outline is accompanied by that fidelity of expression which is capable of producing in those who inspect the plans, all the ideas which the observer had formed from the aspect of the country.

From all that has been said, we may conclude, that the aërostatic art combines properties no less valuable than unquestionable in topographic operations and military researches; that its perfection may produce new and invaluable properties; and that it would be equally impolitic to neglect the use of these machines, or not to obtain for them the information to be derived from reflection and experience. We shall terminate this memoir by an observation relative to their military uses. Our enemies would not fail to oppose to the creative industry of France, an industry of imitation: they would also have their

their balloons and ballooners. The influence of this innovation in war is of a nature to spread with rapidity, and it must soon cease to favour any nation exclusively. But even in this case the art of aërostatic machines will have acquired a higher degree of interest, because another element will then be in the power of man, in which the efforts of genius and industry may be substituted instead of the inconsiderable devastations of force; and this observation ought to interest the friends of humanity in bringing them to perfection.

Method of procuring very strong Vinegar at a trifling Expense.

From the BIBLIOTHEQUE PHYSICO-ECONOMIQUE.

THE manufacture of oiled cloths consumes a great quantity of vinegar. The acetite of iron (solution of iron in vinegar) is the material employed in the colouring to obtain from madder all the red-browns and the various shades of violet. These colours are the more brilliant and vivid according to the superior quality of the acid employed.

The vinegar of the shops varies *ad infinitum* both in price and quality; it would therefore be highly advantageous to the manufacturer to prepare himself a vinegar of a good quality, and always of equal strength. The following process promises this advantage. It is extracted from a theoretical and practical course of lectures on painting, held at Berlin, under the auspices of government by that able chemist professor Westrumb.

Take twenty pounds of unripe grapes, together with the stalks; bruise them in a mortar, and put them into a hogshead holding 68 gallons or 272 quarts.

In a boiler of copper, or preferably of tin, boil 150 quarts of river water with four pounds of red tartar. When the tartar is dissolved, add six pounds of common treacle. Pour the whole over your grapes, and lower the temperature by the addition of fifty quarts of cold water and two quarts of yeast. Observe that the vessel be filled only to about an inch below the bung-hole. After having well mixed the composition, remove it to a place where a regular heat of twenty to twenty-five degrees of Reaumur is maintained.

The fermentation takes place in the course of a few days, and continues sometimes for a month. When it has ceased, which may be known by the absence of the froth which covered the liquid and the vinous odour which succeeds the pungent smell it before exhaled; the bung-hole must be closed, and the vessel left perfectly quiet for a fortnight, that the liquor may become clear.

At the expiration of that time draw off the liquor by means of a cock; add eight quarts of brandy and six of common vinegar; place the vessel in a moderately warm situation, in summer under cover; let the liquor be six or seven inches lower than the bung-hole, which must be left open. A few weeks will be sufficient to convert it into very strong vinegar.

As soon as you find it of sufficient strength, remove it into another vessel, and keep it carefully bunged. The prime cost of the Berlin measure, weighing 2¼ pounds, is 8 to 10 pfennings, or about one penny of English money.

Memoir

Memoir on Vinous Fermentation. *By* M. THENARD.

From the ANNALES DE CHIMIE.

VINOUS fermentation being considered of more importance, has hitherto occupied a greater portion of attention than acetous and putrid fermentation. The latter, however, is perhaps, neither less remarkable nor less worthy of reflection, but it is natural to attach more interest and value to what is more immediately useful.

The period assigned to the discovery of vinous fermentation, appears too certain to admit of a doubt. All historians agree in asserting that the most ancient nations knew how to prepare spirituous liquors. It, therefore, originated in the most remote ages; and, it would indeed be surprising if it had escaped the observation of the first of men. An ebullition arising spontaneously in the bosom of a liquid, an entire mass, rising of itself, a sweet liquor becoming vinous, the conversion of a saccharine matter into ardent spirit, is certainly extraordinary, calculated to strike the attention, and to excite a desire of discovering its original cause. Thus, as it is the first phenomenon that fell under the observation of mankind, so none has been the subject of more reflection, or has given occasion to more numerous experiments; and yet, by one of those contracts rarely met with in the annals of science, though the most studied, it is, perhaps, the one with which we are still least acquainted. It has always been a species of rock on which the efforts of chemists of all ages have suffered shipwreck. Becher, so celebrated for his knowledge of subterraneous nature; Staahl, the Nestor of ancient chemistry; Boerhaave, who formed such sublime ideas; Rouelle, to whom the science is indebted for a part of the improvements made in it

during the last half century that has elapsed; Macquer, that master of the art of composition; and many other celebrated chemists, have failed in attempting to develope this mystery of nature. Lavoisier, who knew how to conquer the greatest obstacles, was the only one, who, illuminating the whole science of chemistry with the torch of his genius, proceeded without losing himself in this obscure path. His researches on fermentation will always be a model for vegetable analyses. He blended in them, as in every thing else he did, that closeness of reasoning and accuracy in the operation, which are characteristic of his manner, and may be regarded as the source of the brilliant discoveries that will ever render his name illustrious. Notwithstanding his luminous researches, much still remains to be done, in order to render our knowledge of this subject complete. Though he has thrown much new light on this department of science, yet the obscurity in which it was enveloped was so profound, that it is still seen, as it were, through a cloud; and this truth did not escape that great philosopher. He was well aware that he had only opened the career, which it remained for others to explore: he would, doubtless, have done it himself, he would have completed what he so successfully began, had not death, envious of his fortune and his fame, terminated his labors.

All our knowledge relative to fermentation is, in fact, confined to this point, that the saccharine matter is converted into alkohol and carbonic acid by means of an intermediate body. But what is the nature of that body? How does it act upon the sugar? It is these two great questions that are the subject of this memoir, and which have frequently been treated of, without having ever been resolved. Some have thought that the fermentable principle resided in the extractive matter; others, rejecting

ing that idea, have concluded that it was in the mucilage, because it much more frequently accompanies the saccharine matter. These, misled by the presence of tartar in wine, have supposed they had discovered in it the real ferment; if they had not confined their observations to the juice of the grape, if they had considered that of other juices in which the existence of that salt cannot be demonstrated by analysis, they would not have fallen into that error. Those, again, inconsiderately adopting every opinion, have asserted, that the mixture of these different matters presided, as it were, over fermentation, effected the decomposition of the sugar, and its conversion into alkohol*. Of these hypotheses, some are evidently

* When I read this memoir to the Institute, I did not mention the admirable experiments of M. Fabroni on vinous fermentation. I confess I was not then acquainted with them; being still young, I shall, perhaps, appear excusable in the eyes of many, particularly when they are informed that Messrs. Guyton, Fourcroy, Vauquelin, Chaptal, Deyeux, &c. &c. were equal strangers to them, though they had proposed as a prize subject the question which forms the principal object of M. Fabroni's researches. I am now anxious to make amends for this involuntary fault.

M. Fabroni has published two memoirs on vinous fermentation; in the first, which was crowned by the academy of Florence in 1787 or 1788, he attributes this phenomenon to the action of the pure vegetable acid on the sugar; and he adds, that a portion of mucilage and a vegeto-animal matter concur as co-effervescent substances, to produce the expeditious movement in the fermentation of common spirituous liquors. In the second, which he read to the Philomathic Society of Paris, when he came to France to assist in that great design the uniformity of weights and measures, he thus expresses himself: "vinous fermentation is the re-action upon the sugar of a vegeto-animal substance (gluten), which Becchari has discovered in flour."

Some have thought that there is a great resemblance between my paper and M. Fabroni's; and can, perhaps, scarcely believe that I was unacquainted with the latter. On this subject I can appeal to the testimony

dently false; others are plausible, and receive from a specious reasoning some degree of probability. But, before

mony of Messrs. Fourcroy, and Vauquelin, to whom I communicated my researches before I presented them to the Institute. But I will add a still more decisive proof. The second memoir of M. Fabroni was printed only in the form of an extract, for which we are indebted to M. Fourcroy. If I had been acquainted with it, should I have read him mine, without mentioning that of the learned chemist of Florence? It may then be asked, how it happened that M. Fourcroy should so completely forget a memoir with which he was perfectly well acquainted; and, particularly, how it was possible for the perusal of another, on the same subject, not to remind him of it. This I know not; but such is the fact. But I suspect, that as it contained only the above-mentioned sentence that refers to the phenomenon of fermentation, and as the author produced no experiment in support of his opinion, this memoir was the less striking, and might have been forgotten in the lapse of time. Supposing, however, that I had been acquainted with M. Fabroni's researches, it is easy to discover that I should not have been able to derive any kind of advantage from them; for I should have begun by repeating his experiments; and should, consequently, have mixed well-washed gluten with sugar and water. On the contrary, the gluten, which M. Fabroni considers as the fermentable principle, has no action upon sugar. (M. Fabroni, without doubt, did not wash his gluten sufficiently, and in that case it is capable of making sugar ferment. We shall presently see the reason of this.) The consequence which I should have drawn from this experiment is evident. Probably, instead of gluten, I should then have mixed a certain quantity of sediment with the sugar and water. (M. Fabroni applies the term, *sediment*, to that matter which disturbs the juice of grapes, and this matter, according to him, is the same as gluten, and by its re-action upon the sugar converts it into alkohol and carbonic acid.) But this sediment, when well-washed, produces no alteration in sugar.

I mean not to assert that the sediment obtained by M. Fabroni did not, with the sugar, produce spirituous fermentation. The grapes which he employed were of a different nature from those which I used; and, on this account, our results may differ. Hence it is obvious, and that is what I wanted to prove, that I had no knowledge of M. Fabroni's

before they are admitted, experience ought to be consulted; without considering any, we ought to derive from observation that theory which is too often previously created. If the genius of Staahl, instead of broaching the system of phlogiston, a substance which never existed but in the brilliant imagination of that extraordinary man, had exerted itself more than it did in developing nature by means of experiments, Staahl would perhaps not have erred; Staahl would probably have discovered the truth, and would have deprived France of the glory of having given birth to the author of the modern theory. Such is the course I have followed; before I formed or adopted any system, I observed the facts, and drew from them such consequences as, I think, ought to lead to the knowledge of what passes in liquors during fermentation. But in such a delicate matter nothing is more easy than to be mistaken; and it is principally to correct my ideas, if they be not just, that I am about to submit to the class the result of my researches.

I made my first observations on the juice of gooseberries. I had powerful reasons for preferring that to any other; its fermentation is the most expeditious, and

broni's researches, before I made similar ones; that the acquaintance with his researches, though of great utility to science, would have been of no advantage to me; and, finally, that there exists a remarkable difference between M. Fabroni's opinion and mine, on fermentation. M. Fabroni attributes it to the re-action of the gluten on the sugar; I prove that it is not owing to the gluten, but to a distinct matter. Besides, M. Fabroni's observations are confined to the juice of the grape; I have examined the question generally; I have considered the juices of all fruits. M. Fabroni imagines, that all the carbonic acid which is disengaged in fermentation proceeds from the carbon of the ferment which seizes upon the oxygen of the sugar; and I demonstrate that $\frac{4}{5}$, at least, proceed from the sugar.

consequently

consequently it is the most proper for elucidating the causes which produce it. All my researches at first tended to discover the matter which serves as a ferment. This, I conceived, would be a great step towards resolving the problem, or at least towards developing a multitude of truths that were still unknown, if I could determine its nature, ascertain whether it is always the same, or whether there are several kinds of matter possessing the same property. This very important question had long struck me; it had frequently occupied my attention, and I entertained the idea of attempting its solution, when the Institute proposed it as the subject of a prize. This was a powerful additional motive with me to turn my thoughts to it. I was by no means inclined to admit several fermentable principles; every thing led me to believe that there was only one, and that this was none of those hitherto imagined, because, in fact, neither extractive matter, mucilage, nor tartar, &c. act upon sugar. But this required a positive demonstration, and though I have not yet obtained proofs perfectly satisfactory on this head, yet as there is no proof of the existence of several kinds, and it appears every where the same, that opinion seems to me to deserve the preference.

I strained, through a fine linen cloth, the juice of a kilogramme of gooseberries; it was thick, and held suspended a matter slightly glutinous, which I separated with the filtre, and washed in a great quantity of water. As nothing ought to be disregarded in those sciences that depend upon observation, I submitted this matter to a regular examination. My first care was to put it, together with some sugar, into water, to see whether it was capable of producing fermentation; I observed that several bubbles of an elastic fluid were soon disengaged, which

which I ascertained to be carbonic acid. The efferves-cence lasted eight days, and, at the expiration of that time, the liquor, which was very pleasant, had only a slightly saccharine taste; it contained a great quantity of alkohol, and so perfectly resembled a wine not quite made, that it might have been mistaken for it. It may well be supposed that I redoubled my zeal and attention in the examination of a substance which presented me what I was seeking; it was natural that I should first see whether the whole were capable of decomposing sugar. As less than a sixth part of its weight was able to effect this decomposition, I thence concluded that it contained, only in a small quantity, the fermentable principle, which I endeavoured, by every imaginable method, to separate from it, and to obtain by itself, but in vain. All that I could do, after this, was to examine it comparatively before and after it had been employed for fermentation. This substance, however, did not appear to be altered by fermentation, it continued insipid, insoluble in water and alkohol, without any power over tincture of turnsol, or syrup of violets; but, when distilled, it afforded no trace of volatile alkali. This result, which did not surprise me, being confirmed by a second experiment, was, however, a ray of light that encouraged me to pursue the path I was following; it shewed me that the germ of fermentation was of animal nature; it agreed with the ideas I had conceived, and imparted to my suspicions an appearance of reality.

TO BE CONCLUDED IN OUR NEXT.

Improved Method of preparing Liquid Ammoniac.

From GÖTTLING's Pocket-Book for Chemists and Apothecaries for the Year 1803.

THE preparation of water impregnated with ammoniac, or liquid ammoniac, may be improved with respect to the proportion of the materials from which it is obtained, and the form of the apparatus in which the process is performed.

It is evident, that in the first point an improvement is still to be desired, if we consider that notwithstanding the diminution in the quantity of lime to be mixed with the sal ammoniac, already made of late years, the quantity of that article, which renders the operation extremely difficult, is still much too great; for the usual proportions are $1\frac{1}{2}$ part of lime to 1 part of sal ammoniac. Upon comparing the proportional affinity of the constituent principles of this salt with that of the principles of muriate of lime, we obtain the following results: 100 parts of sublimated muriate of ammoniac contain 69 parts of ammoniac and water, and 31 parts of muriatic acid. To saturate these 31 parts of acid, and to set the ammoniac at liberty, 44 parts of pure lime are necessary; which, with 31 parts of acid and 25 of water, compose, according to Bergman, 100 parts of muriate of lime. According to this statement, 16 parts of muriate of ammoniac, containing about $5\frac{1}{3}$ ounces of muriatic acid, would not require quite $7\frac{1}{2}$ parts of lime; but as common lime is not pure, and contains a small quantity of clay, iron, and silica, that proportion ought to be augmented. According to my experiments, 12 parts of lime are sufficient to decompose 16 parts of sal ammoniac, and, by taking equal

equal parts of those two substances, no other risk is incurred excepting that part of the sal-ammoniac may remain undecomposed.

With regard to the kind of apparatus to be employed, improvements still remain to be made, as will be readily acknowledged by all those who have once prepared liquid ammoniac.

We know that ammoniac is so volatile, that when distilled with water it first passes over in the form of gas, and endangers the breaking of the retort, especially if every vent be closed; and by leaving a vent, the quantity of ammoniac which passes over before the vaporisation of the water is lost.

This danger, it was conceived, would be avoided by putting water in the recipient, or by operating with Woulfe's apparatus. These methods are either not very practicable, or not the most advantageous to the apothecary. The first is not practicable, for this reason, because, by merely putting water into the apparatus without plunging into it the neck of the retort, the contact of the ammoniacal gas with that liquid is not sufficiently close to condense the gas as fast as it is disengaged: the second is neither practicable nor advantageous, because the arrangement of Woulfe's apparatus is not only extremely troublesome, but the apparatus itself is too expensive for common operations.

In the following process, these several inconveniences are corrected.

Slake 16 ounces of lime, well burned, with a sufficient quantity of water to make it into a liquid paste. Put this paste into a stone or glass retort, add 16 ounces of pulverized sal ammoniac, and cover the mattrass with a cap, to which must be adjusted a tube, of sufficient length to reach to the bottom of the recipient. Mark

 on

on the recipient the height to which, when it is adapted to the mattrass, 48 ounces of water would rise; put in it the half of that quantity of water, and fasten it to the cap. Then lute all the interstices with paste, made of flour and gypsum, and proceed to distillation in the usual manner. The extremity of the tube being plunged into the water, the ammoniacal gas is immediately absorbed, and the operator need not be under any apprehension either of bursting the vessels, or of sustaining the smallest loss of ammoniacal gas. In this operation we know that the condensation of the gas heats the liquid. Continue the distillation till the liquid has reached the point marked. Thus, without the least danger to the vessels, or any loss of the material, 48 ounces of highly saturated spirit of sal ammoniac are obtained.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Composition for covering the Stems of Trees.

MR. Forsyth in a postscript to a new edition of his work on fruit-trees, which will shortly be published, inserts a letter, signed by several medical gentlemen of eminence, confirming the efficacy of his process for renovating trees. He also mentions a discovery which he has recently made, and which, as being calculated to save time and labour, may deserve attention. Instead of paring away the bark, as had heretofore been the practice, and covering the stem with the composition, he now merely scrapes off the loose bark, and applies a mixture of cow-dung and urine only, (made to the consistence of a thick paint),

paint), with a painter's brush; covering the stem carefully over. This softens the old scabrous bark, which peels off during the following winter and spring, and is succeeded by a fine smooth new bark.

Threshing-Mill.

Messrs. Edes and Nicholls, of Elm, in the Isle of Ely, have had a threshing-mill built, by Mr. Wigfull, of Lynn, which they have used for three seasons. It was made for four horses, but altered for six. It cost 100 guineas; threshes with ease fifteen to twenty quarters of wheat, twenty-five to thirty-five of oats in a day, and would do more; requires two women, three boys, and two men. It performs its work with every sort of grain, so much to their satisfaction, that they are now building a second at another farm; and is so far superior to the flail, that trying the straw of two men's threshing in a day and a half, one bushel of clean wheat was gained.

Parsnips.

The Earl of Romney tried an acre of parsnips at the Mote, and his success was such, as to give him reason to think the culture highly profitable. He gave them to his cows, and these yielded milk in uncommon quantity, aud better than any other food he has tried; the cows were as eager for this food as for oil-cake.

Hemp.

Mr. Leeds, of Somersham, in Huntingdonshire, upon a black peaty soil, made-land, having been the bed of an old river, much over-run with nettles and other rubbish, sowed hemp on six acres three roods; he got two last and one half of seed, without taking the advantage of picking the femble hemp; after threshing he stacked it, and in the spring watered and dressed it. Produced 350 stone, or above 50 *per* acre. It cleaned the land completely.

Manures.

Mr. Thompson, at Waverley-Abbey, in Surrey, has used graves from the London tallow-chandlers, with very great success on a sandy soil: 10 cwt. *per* acre, at 3*s.* *per* cwt. have had this year an effect for turnips, that is extraordinary. Laid on the poorest part of a field, they have pushed forward the crop beyond the best soil in it; and rendered it so very superior, that probably no common dressing of the richest dung would have exceeded, nor any common manure equalled it. They were tried on two fields, and the effect the same in both.

Lord Mulgrave's Premiums.

On the 3d of October Lord Mulgrave distributed his annual premiums among his tenants and cottagers. The rewards to the tenants for the best management in different branches of husbandry consisted of silver cups and medals of different value. The rewards to the cottagers were substantial, and to them of great value.

The cottager who had brought up the greatest number of children, and given them a religious and useful education, without any parochial relief, received a good milch cow; the second most deserving cottager, under the same regulations, obtained a milch cow also; and the third a suit of clothes. As his lordship has given gardens to his cottagers, rewards were given to those who had their gardens in the best condition, and had rendered them most productive in useful vegetables. Though this is only the second year, the advantages of this institution are already visible on his lordship's estate, from the happy spirit of emulation it excites in every farmer and cottager.

Preventive

Preventive of the Plague.

Dr. J. de Carro, of Vienna, in a letter to Dr. C. Haug, of Rastadt, has communicated a new discovery made by Dr. Lafond, of Salonica, in Macedonia, and Dr. Aubon, of Constantinople, that vaccination is a preservative against the plague.—The experiments of Dr. Aubon prove that of 6,000 persons inoculated with the vaccine at Constantinople, not one of them was attacked by the plague; that children subjected to the vaccine inoculation were made to suck mothers attacked by the plague, without any of them being infected; that an Italian physician, who devoted himself in Turkey to the study of the plague, being fully convinced of the property which the vaccine has of preserving from this malady, took every opportunity of coming into contact with persons infected by the plague. The vaccine pustules have been found on the teats of the cows, and the hands of them who milk them, in the villages round Constantinople. When an inhabitant of these villages has been infected with the plague in distant countries, and returns with that malady, he has either died or been cured without the disorder spreading: in the last place, the confidence of several classes of men, and chiefly of the Armenians, in the preventive quality of the vaccine against the plague, is so great, that a number of people are inoculated every year with it to preserve them from this malady.

Method of giving to Malt-Spirit the Flavour of Brandy.

In a late number of the Bibliothéque Physico-Economique is inserted the following method of giving to malt-spirit the flavour of brandy. Into two quarts of malt-spirit put three ounces and a half of powdered charcoal and

and four ounces and a half of ground rice. Let these ingredients remain about 15 days, taking care to agitate them frequently during that time; filter the liquor, and its flavour will be found very much improved.

Wool of New South Wales.

A specimen of wool has been brought from New South Wales, which is deemed superior in softness, and in every other respect equal to the best Spanish wool, and worth about six shillings *per* pound. The sheep producing it were originally sent from Spain to the Cape of Good Hope, and thence to Port Jackson. Captain M'Arthur, who has devoted much attention to improve his flock in this colony has now about 4,000 sheep with Spanish rams: he calculates, that with proper care the number will double itself every two years and a half; and that in twenty years his stock will be so much increased as to produce a quantity of fine wool, equal to that now imported from Spain and other countries at an annual expence of 1,800,000 *l.* sterling.

List of Patents for Inventions, &c.

(Continued from Vol. III. Page 480.)

Robert Atkins, of Fenchurch-street, in the city of London, Mathematical Instrument-maker; for improvements in the construction of hydrometers, for ascertaining the strength of spirituous liquors; and a sliding rule of correction for temperature to the hydrometer, and various improvements thereof.
Dated October 31, 1803.

Edward Thomason, of Birmingham, in the county of Warwick, Button and Toy-manufacturer; for a new mode of making hearth brushes.
Dated October 31, 1803.